US009164470B2

(12) **United States Patent**
Sakashita et al.

(10) **Patent No.: US 9,164,470 B2**
(45) **Date of Patent: Oct. 20, 2015**

(54) **TRANSFER DEVICE AND ATTACHMENT OF THE TRANSFER DEVICE TO A COVER OF AN IMAGE FORMING APPARATUS**

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(73) Assignee: **RICOH COMPANY, LIMITED**, Tokyo (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 32 days.

(21) Appl. No.: **14/025,017**

(22) Filed: **Sep. 12, 2013**

(65) **Prior Publication Data**

US 2014/0079434 A1 Mar. 20, 2014

(30) **Foreign Application Priority Data**

Sep. 18, 2012 (JP) 2012-203910
Nov. 30, 2012 (JP) 2012-263431

(51) **Int. Cl.**
G03G 15/16 (2006.01)
G03G 21/16 (2006.01)

(52) **U.S. Cl.**
CPC ***G03G 21/1623*** (2013.01); ***G03G 15/16*** (2013.01); ***G03G 21/1633*** (2013.01)

(58) **Field of Classification Search**
USPC 399/121
See application file for complete search history.

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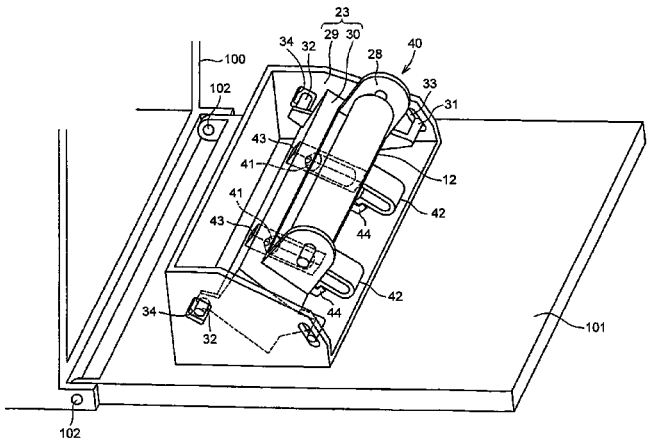
Primary Examiner — Quana M Grainger
(74) *Attorney, Agent, or Firm* — Oblon, McClelland, Maier & Neustadt, L.L.P.

(57) **ABSTRACT**

An image forming apparatus, includes: a main body; a cover configured to be provided so as to be capable of being opened and closed with respect to the main body; an attachment unit configured to be provided on the cover; a unit configured to be attached to the attachment unit; a positioning member configured to, on closing of the cover, position the unit with respect to a member attached to the main body or the main body; a guiding member configured to guide the unit to the positioning member; and a protrusion configured to be provided at the guiding member to protrude in an attaching direction of the unit.

21 Claims, 21 Drawing Sheets



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U.S. Appl. No. 13/924,923, filed Jun. 24, 2013.

* cited by examiner

FIG.1

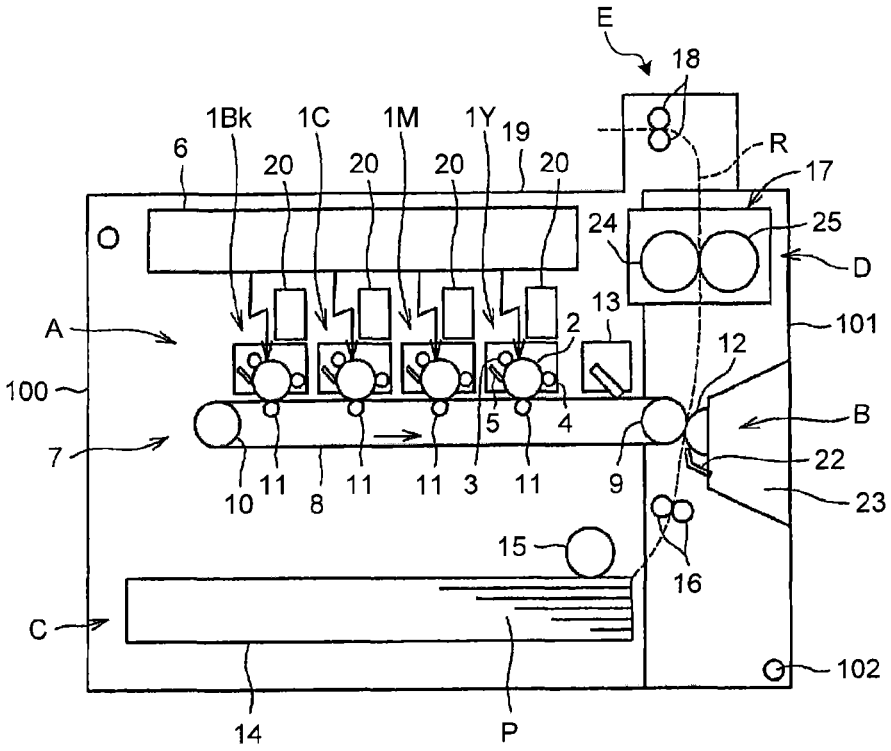
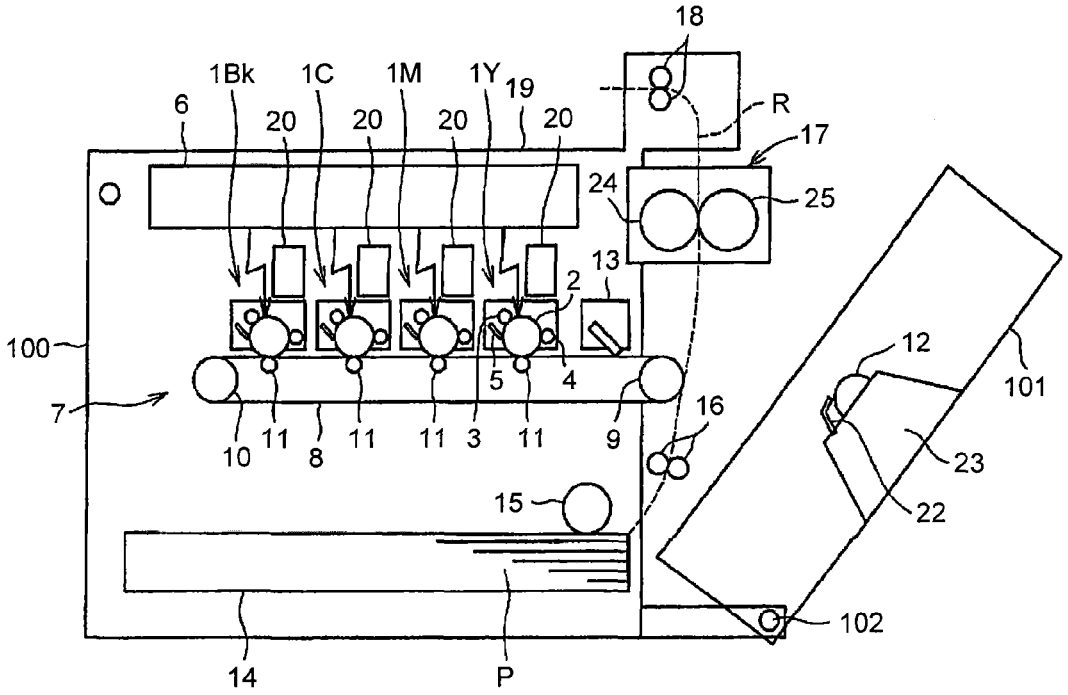

E
18
1Bk
1C
1M
1Y
19
6
20
20
20
20
R
17
24
25
D
13
2
101
A
12
100
B
5
4
7
22
10
11
8
11
11
3
11
9
23
15
16
C
102
14
P

FIG.2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1Y
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R
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24
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13
2
12
101
100
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11
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11
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3
11
9
23
22
15
102
14
P

FIG.3

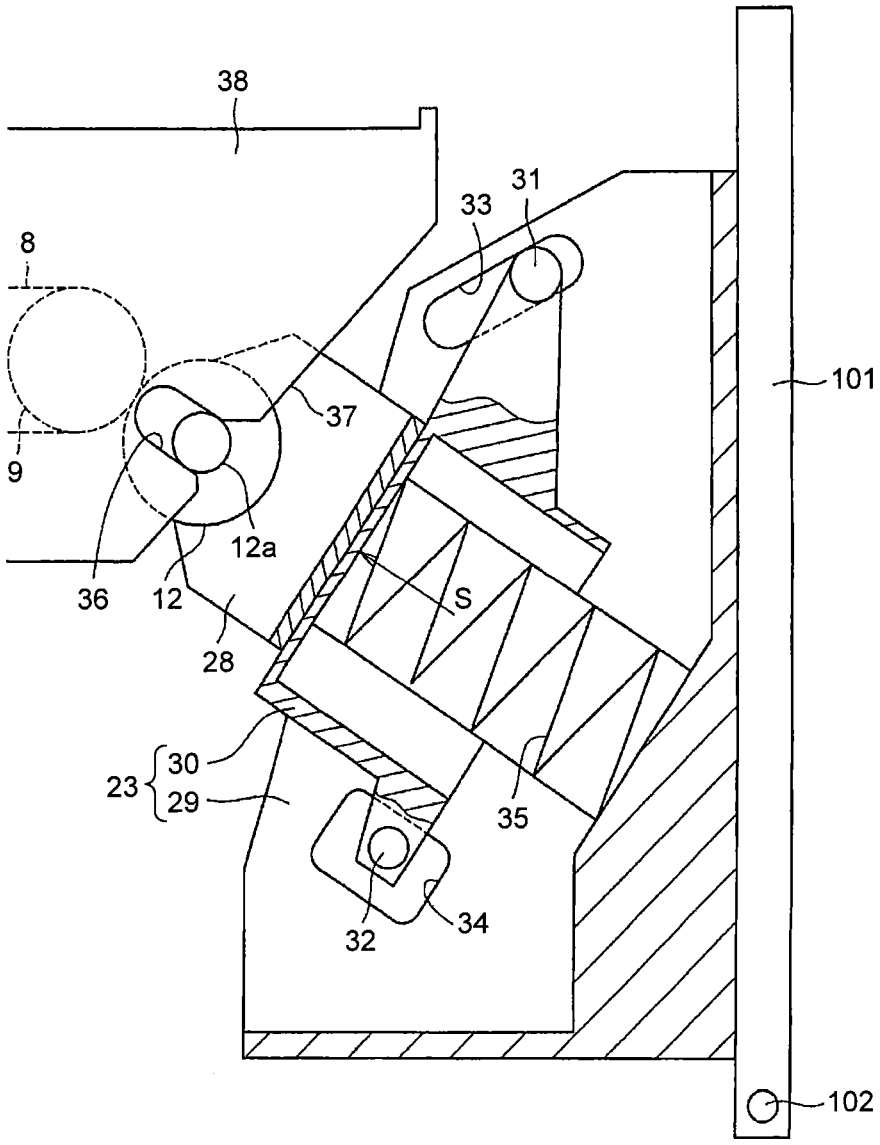


FIG.4

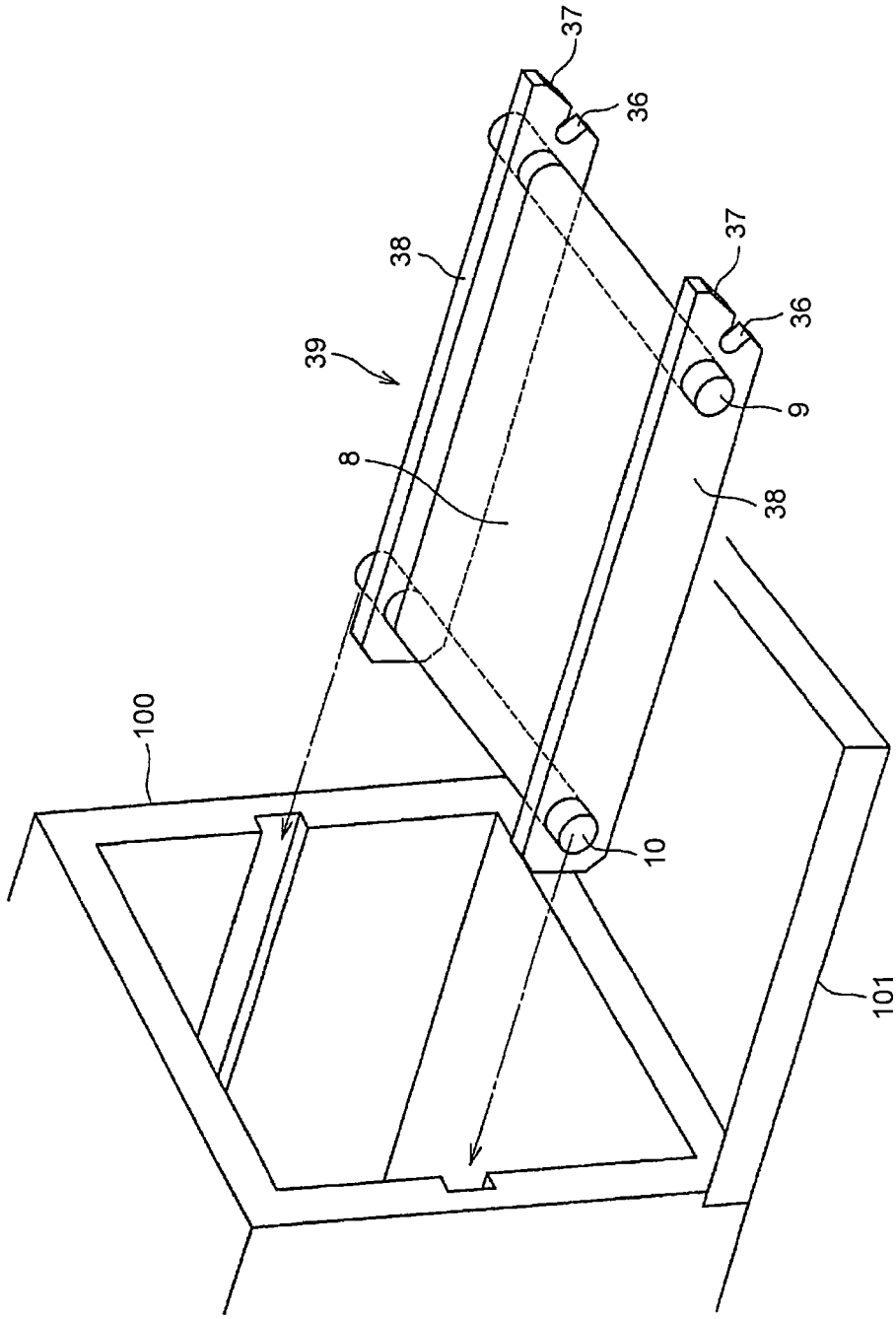


FIG.5

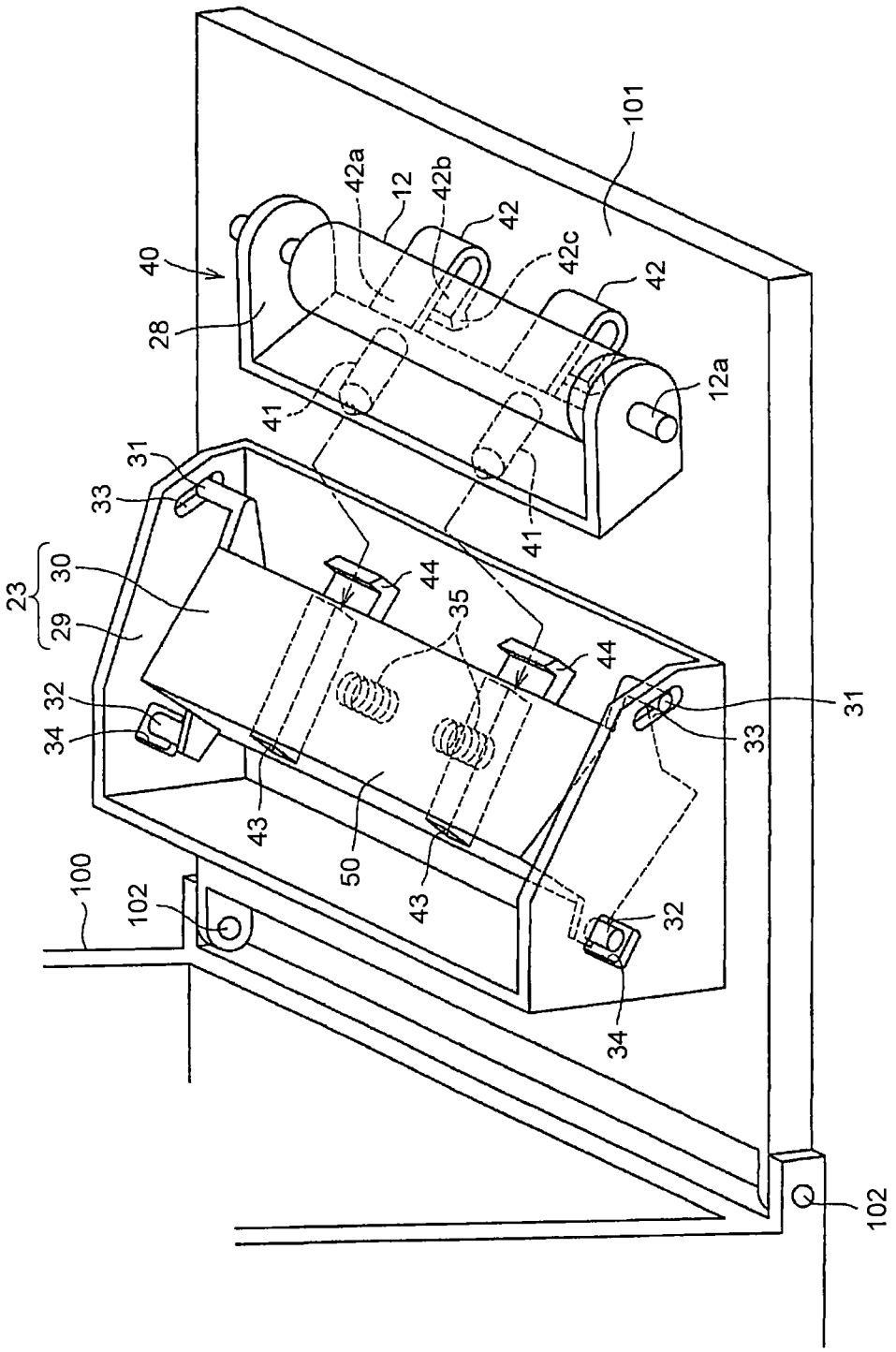

101
42a
12
42b
42
42c
42
40
28
12a
41
41
31
33
23
30
29
44
35
44
31
32
34
33
43
50
43
32
100
102
34
102

FIG.6

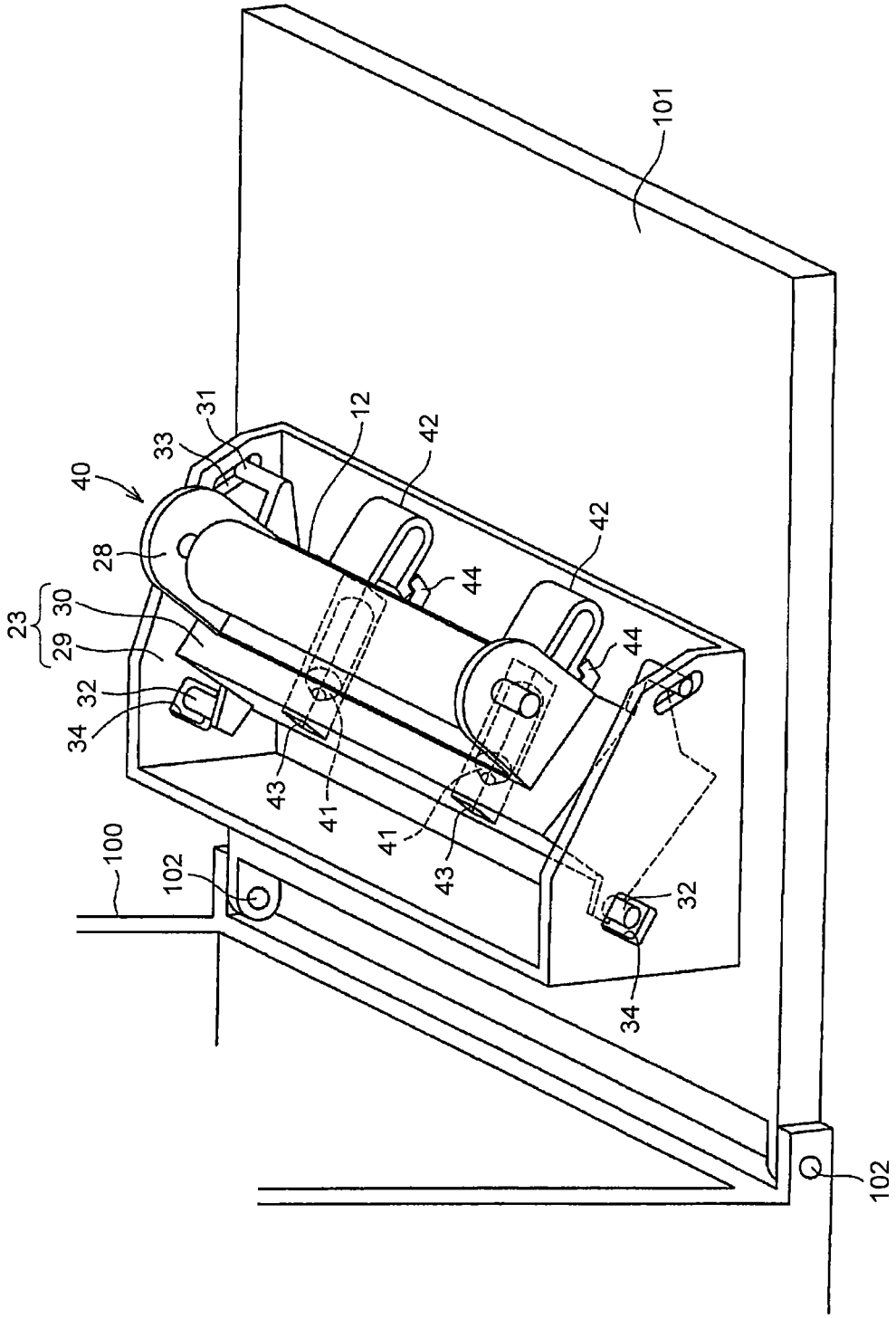
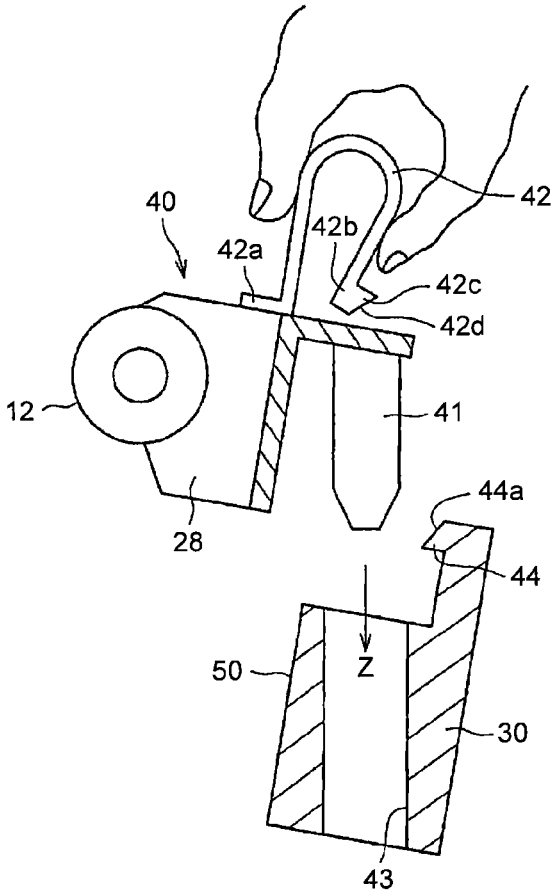

101
31
33
40
12
42
42
28
44
23
30
29
44
32
34
43
41
41
43
100
102
32
34
102

FIG.7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42c
42d
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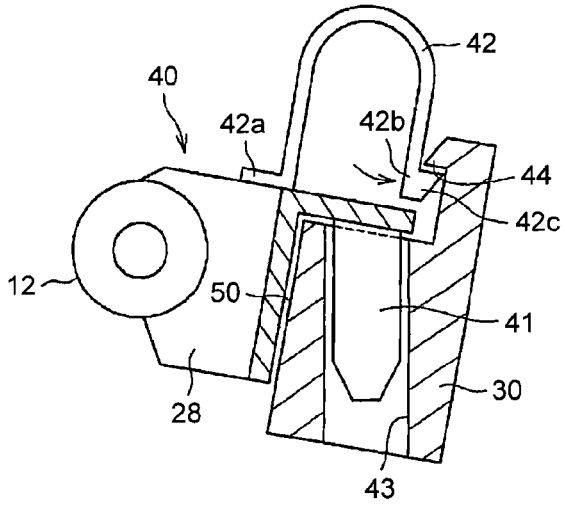
41
28
44a
44
50
Z
30
43

FIG.8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42a
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42c
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50
41
28
30
43

FIG.9

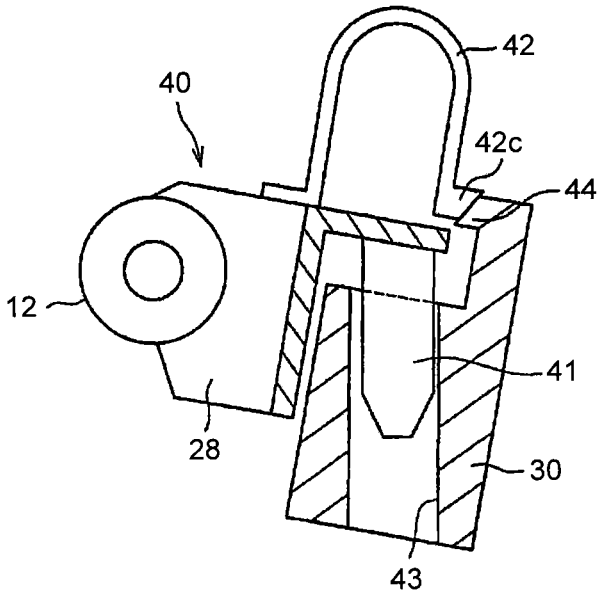

42
40
42c
44
12
41
28
30
43

FIG.10

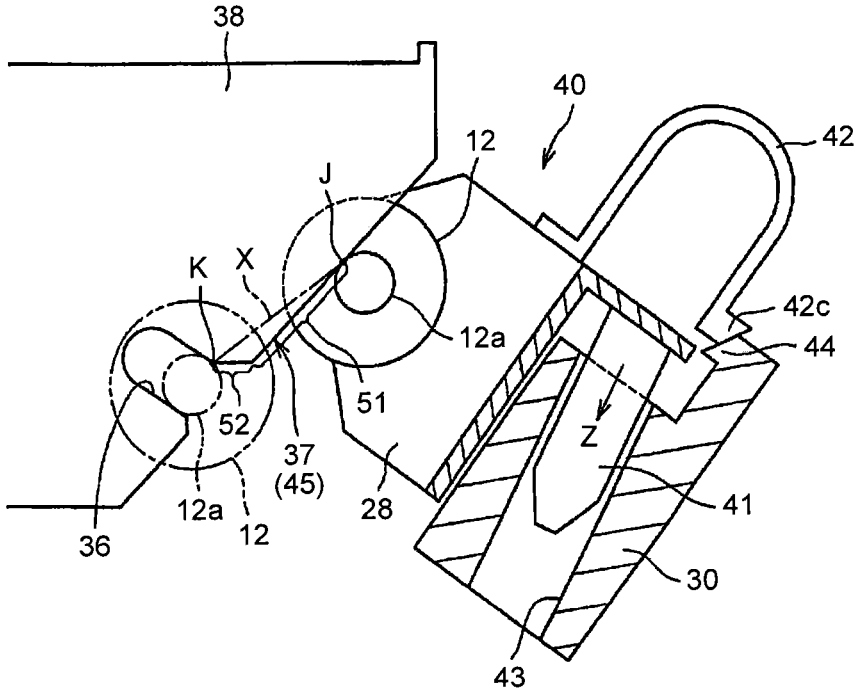

38
40
42
12
J
K
X
42c
12a
44
51
52
37
(45)
Z
28
41
12a
12
36
30
43

FIG.11

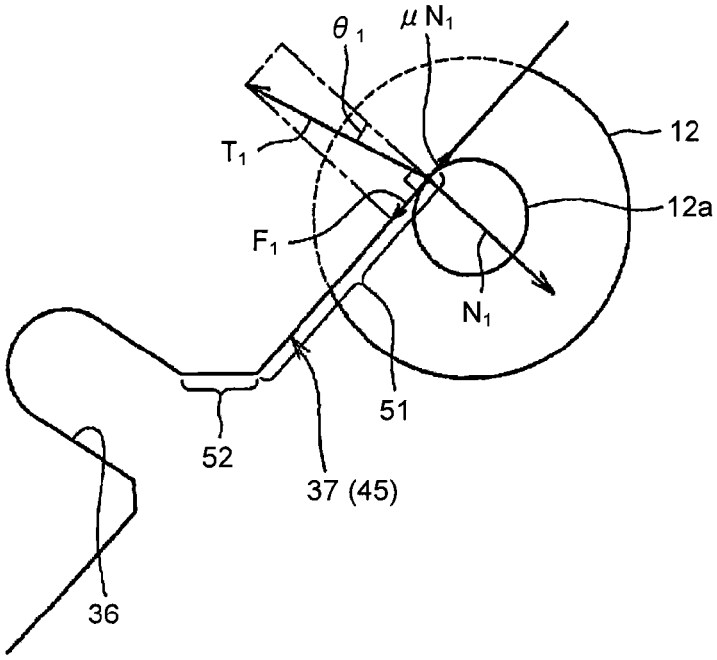

θ 1
μ N1
T1
12
12a
F1
N1
51
52
37 (45)
36

FIG.12

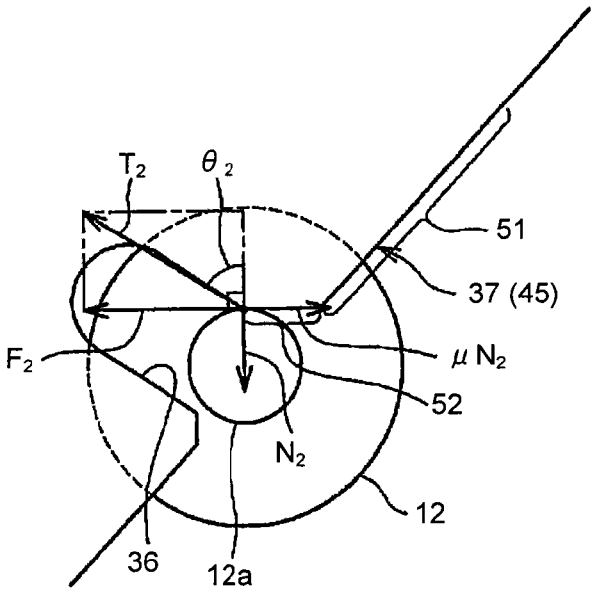

T2
θ 2
51
37 (45)
μ N2
F2
52
N2
12
36
12a

FIG.13

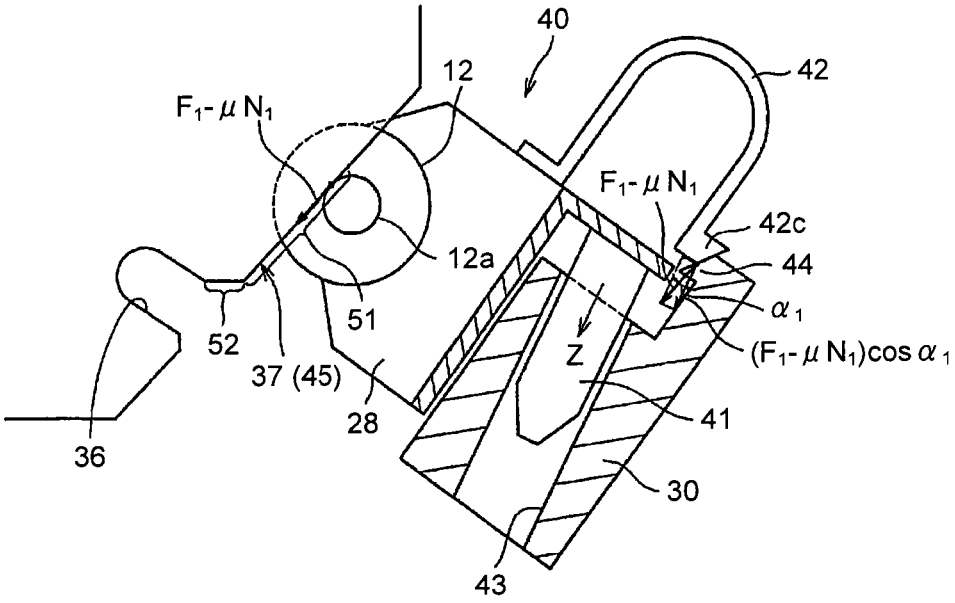
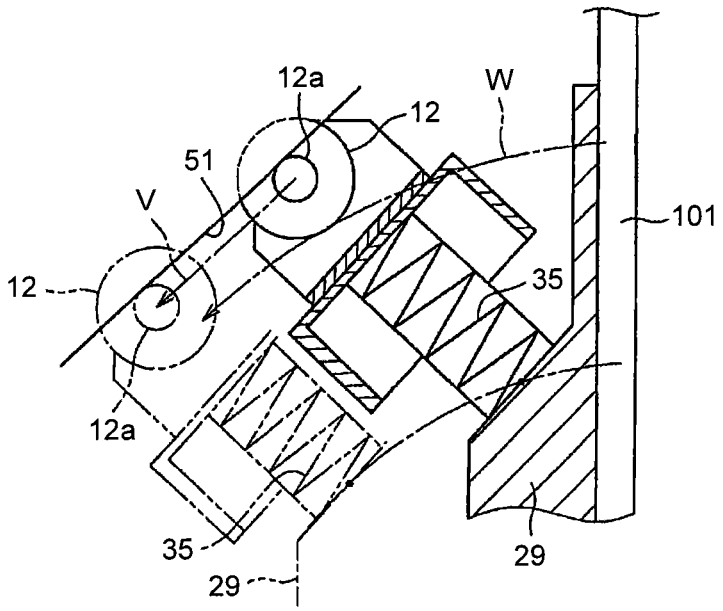

40
12
42
$F_1-\mu N_1$
$F_1-\mu N_1$
42c
12a
44
α_1
51
52
37 (45)
Z
$(F_1-\mu N_1)\cos\alpha_1$
28
41
36
30
43

FIG.14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51
V
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12a
35
29
29

FIG.15

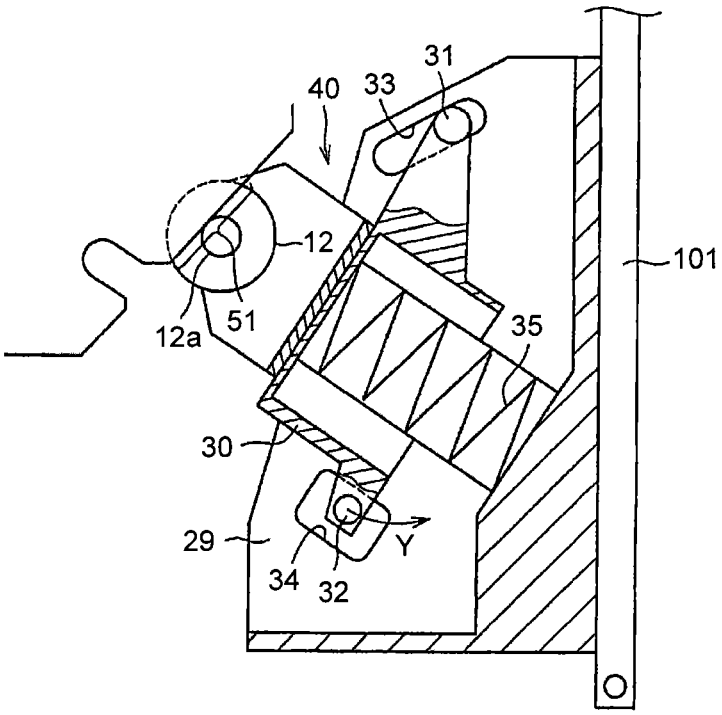

FIG.16

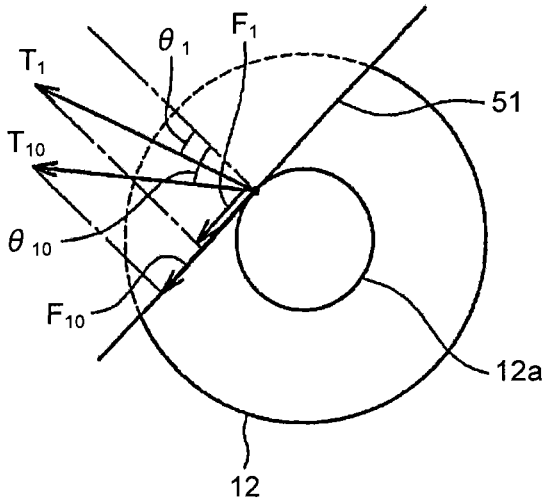

FIG.17

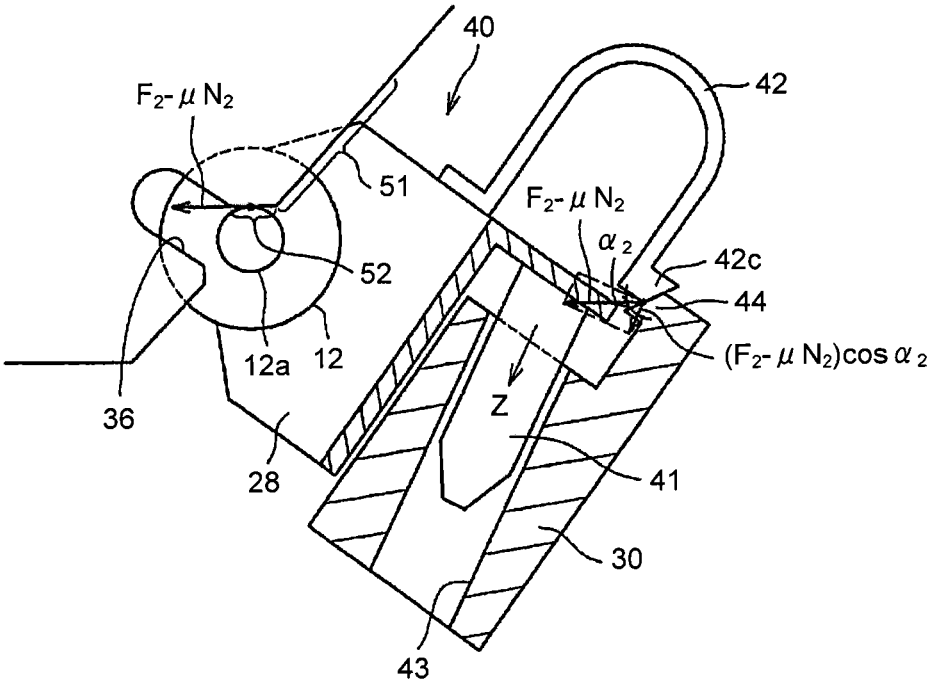
40
42
F_2-μ N_2
51
F_2-μ N_2
α_2
42c
52
44
$(F_2$-μ $N_2)\cos\alpha_2$
12a
12
36
Z
28
41
30
43

FIG.18

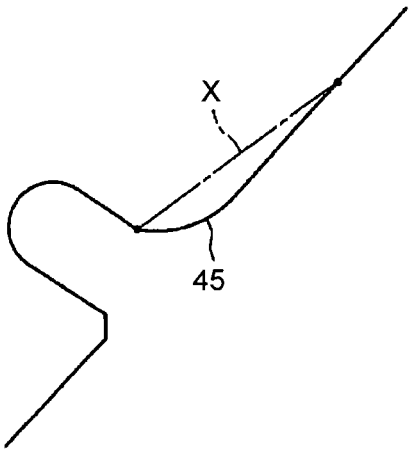
X
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FIG.19

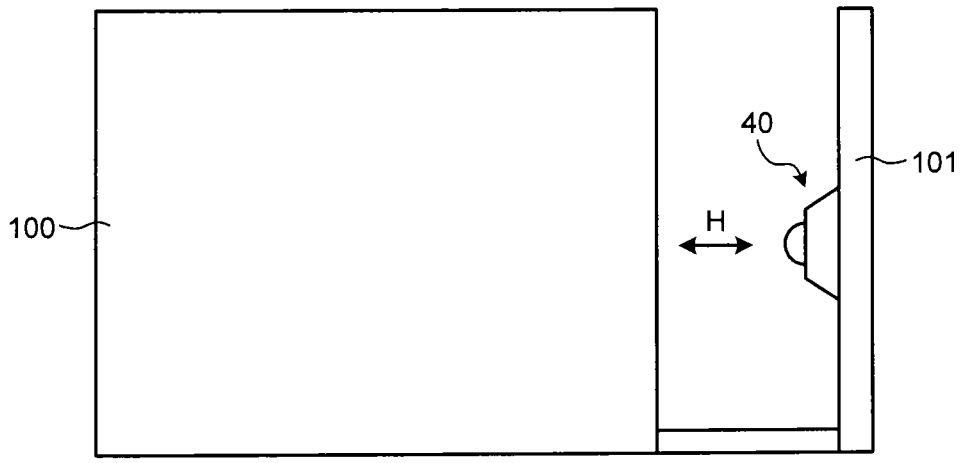
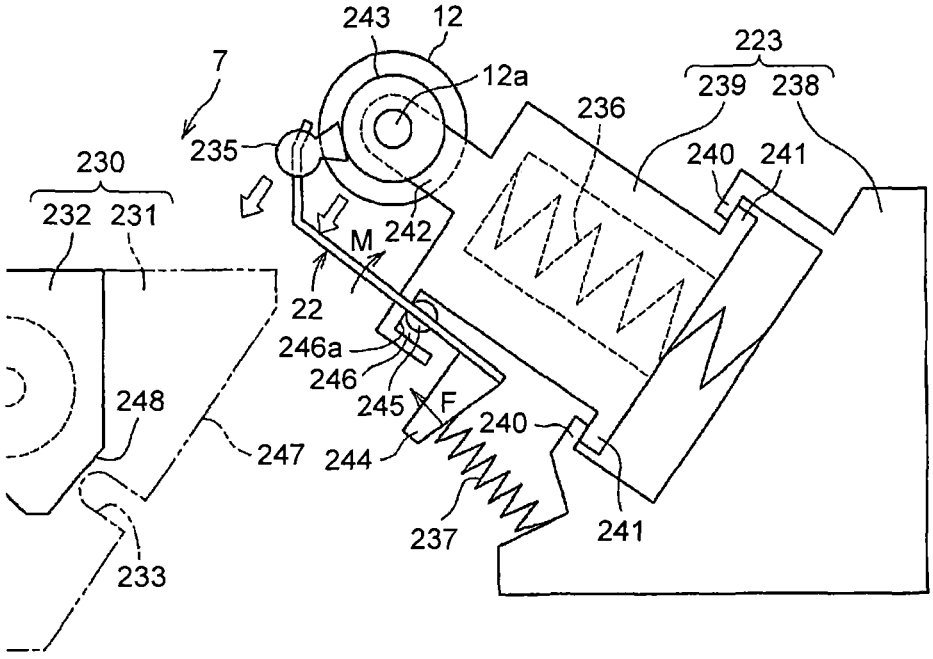


FIG.20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246a
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245
F
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248
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244
237
241
233

FIG.21

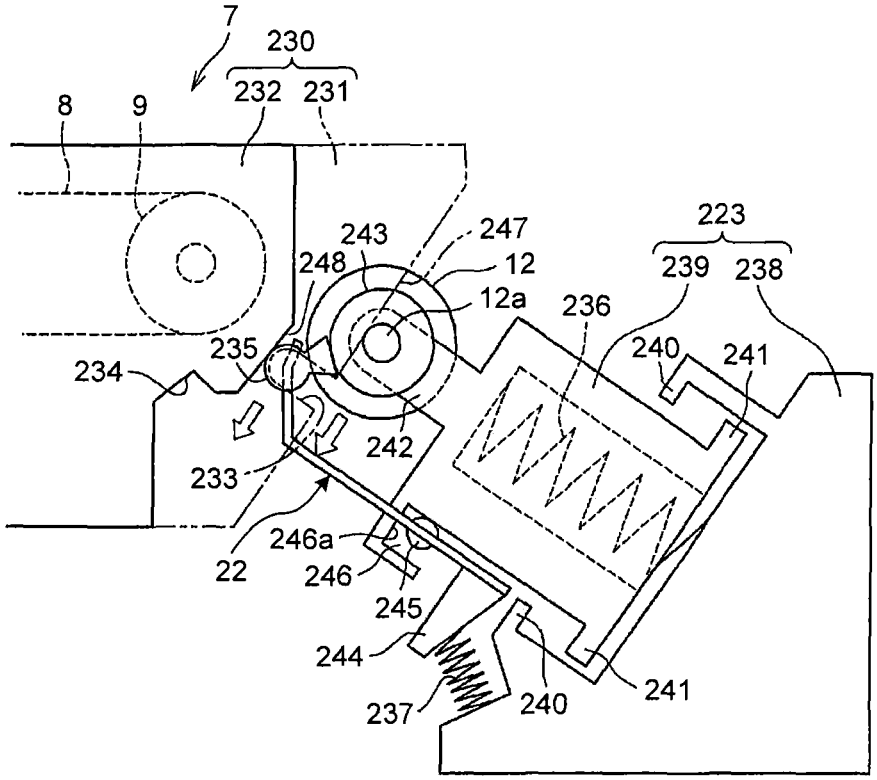
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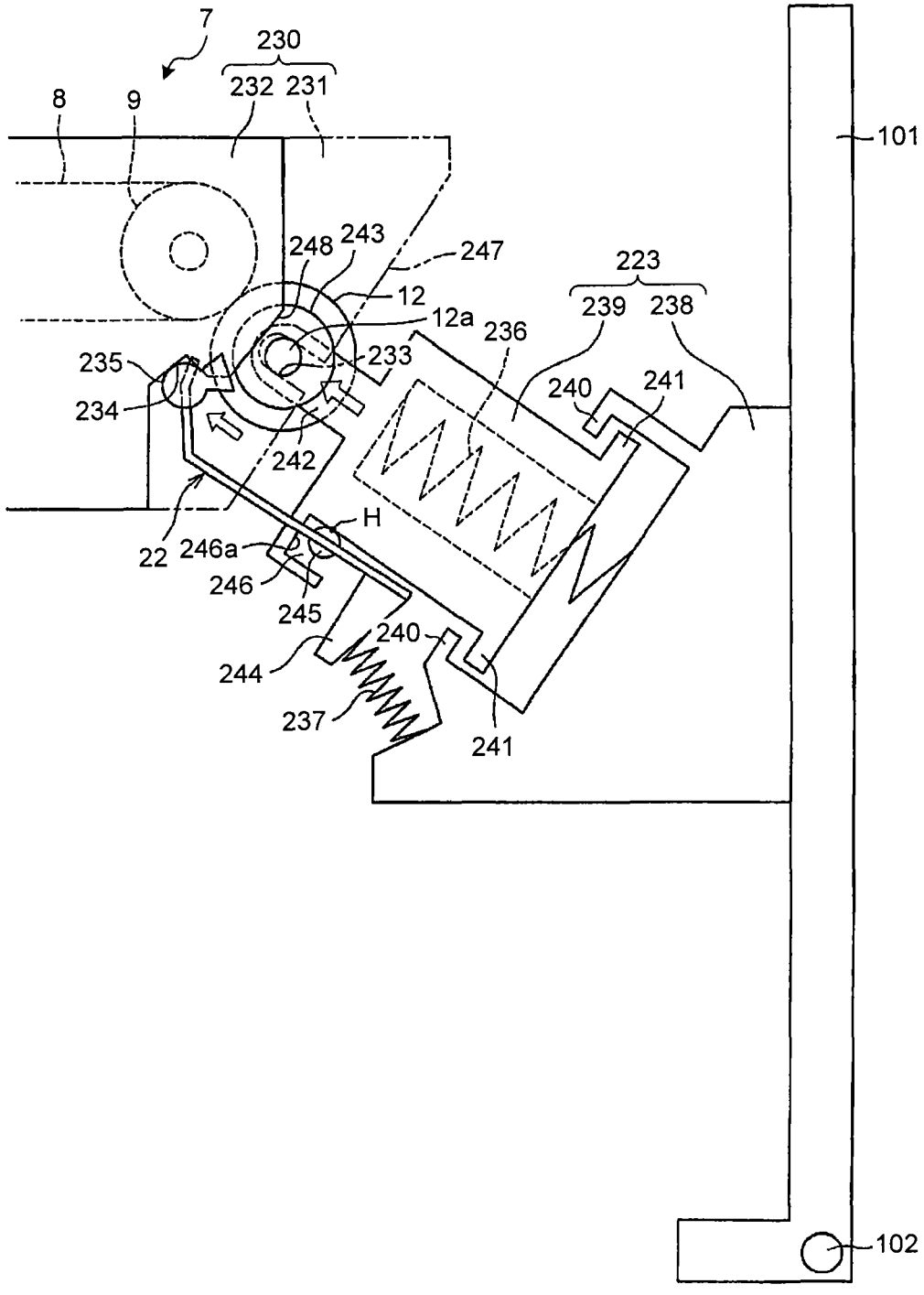
FIG.22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223
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H
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FIG.23

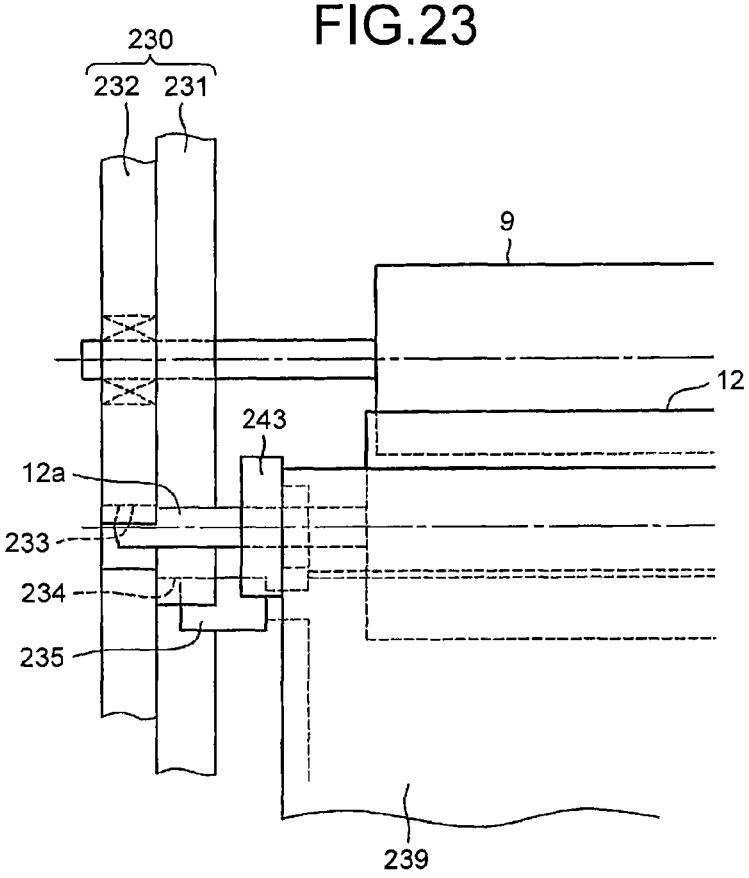
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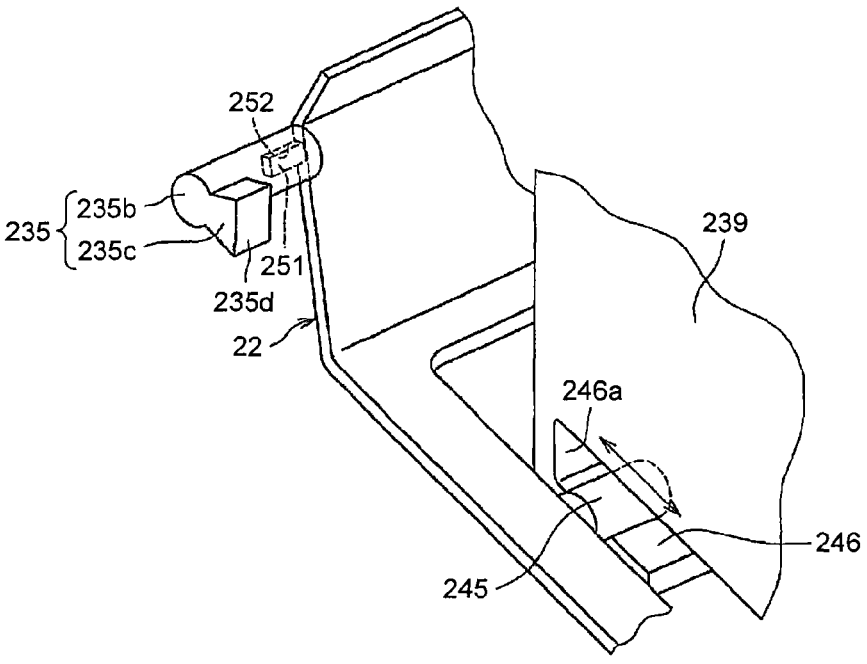
FIG.24


252
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235d
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246a
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FIG.25

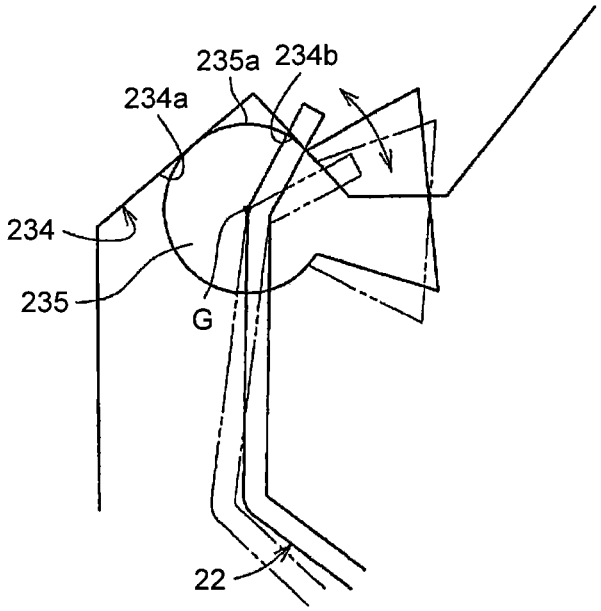


FIG.26

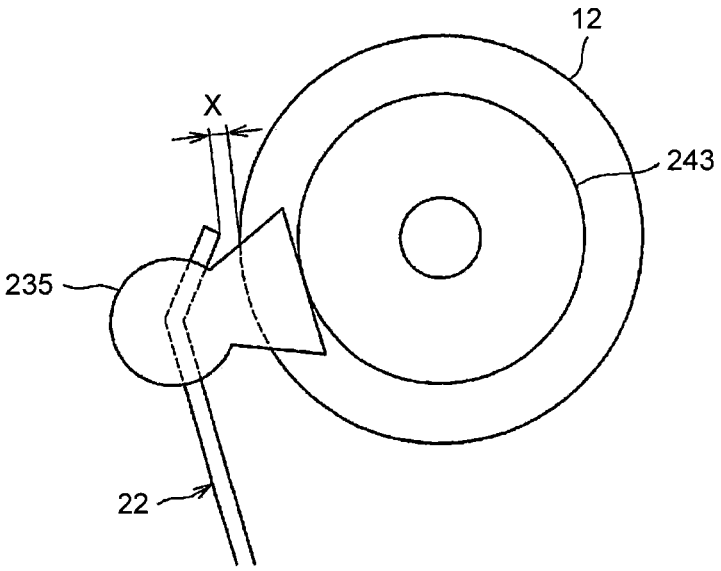


FIG.27

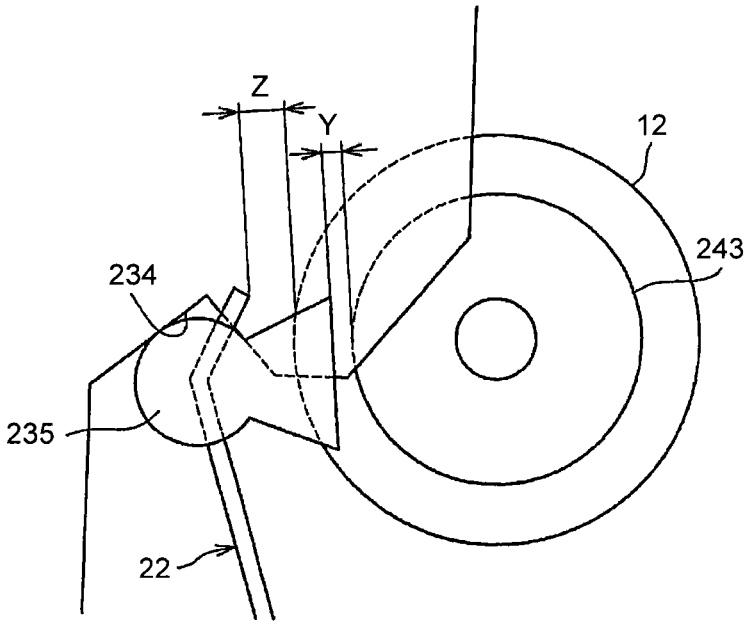


FIG.28

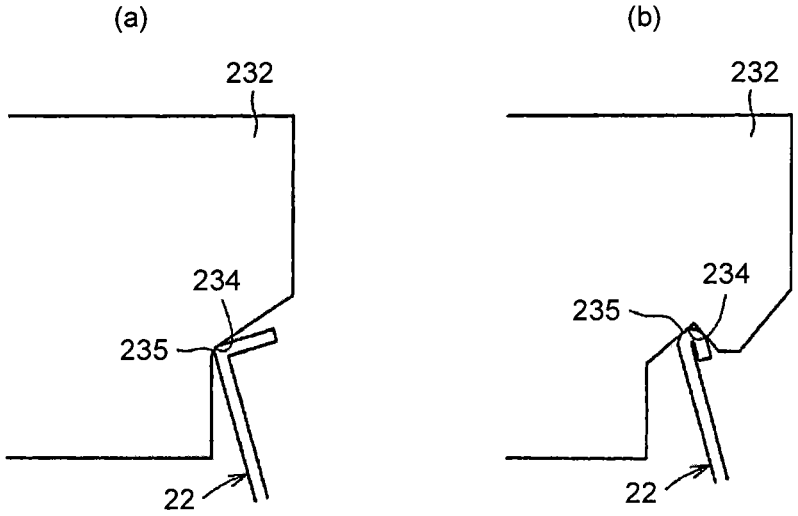


FIG.29

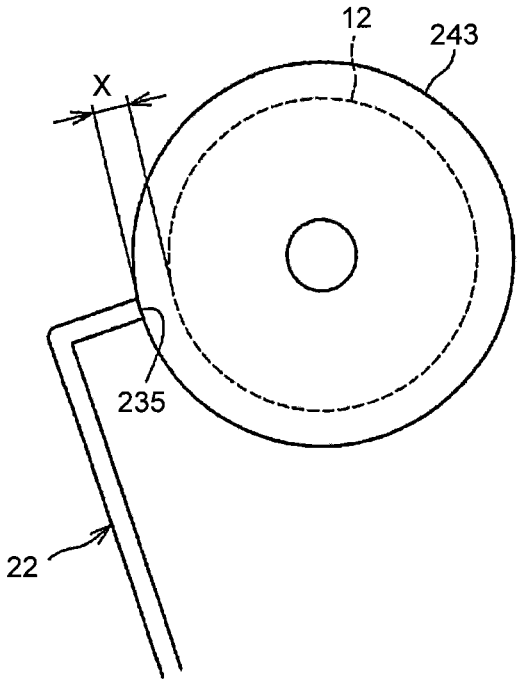


FIG.30

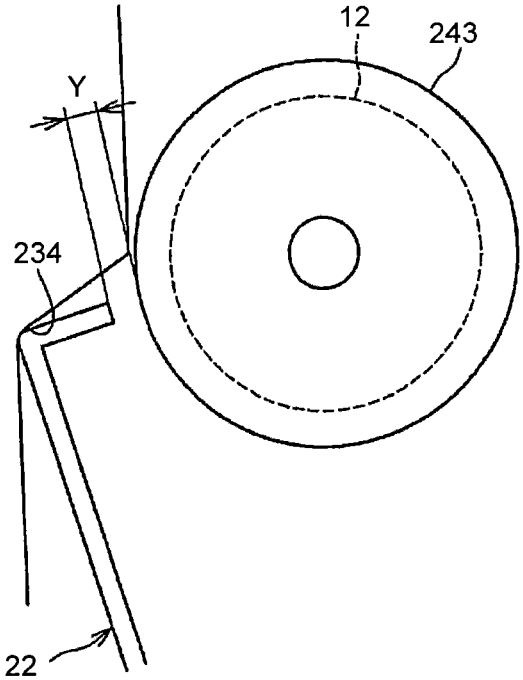


FIG.31

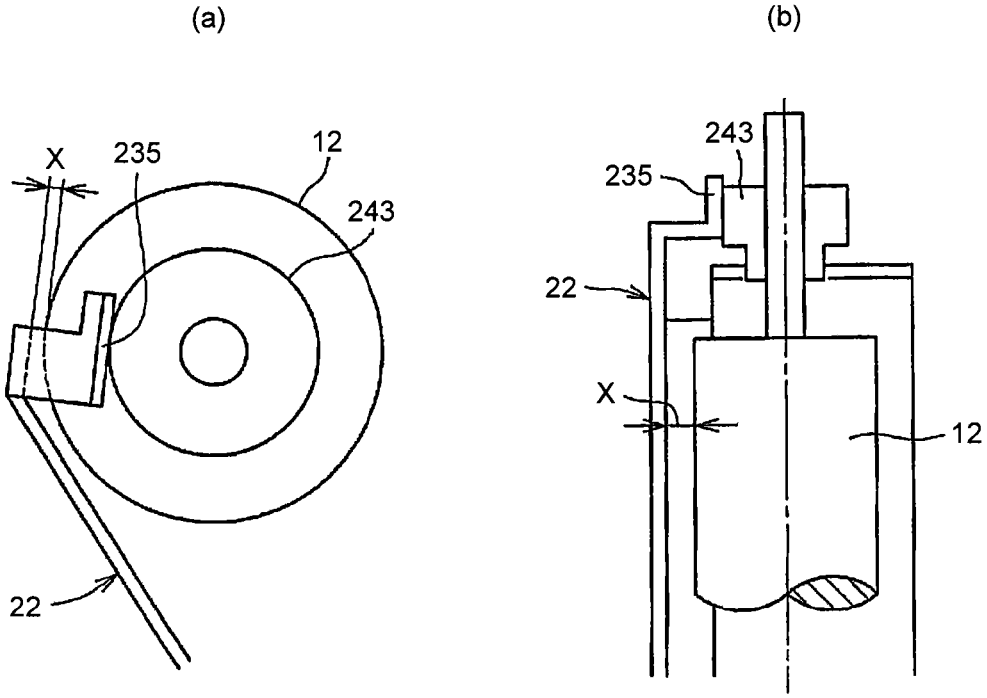


FIG.32

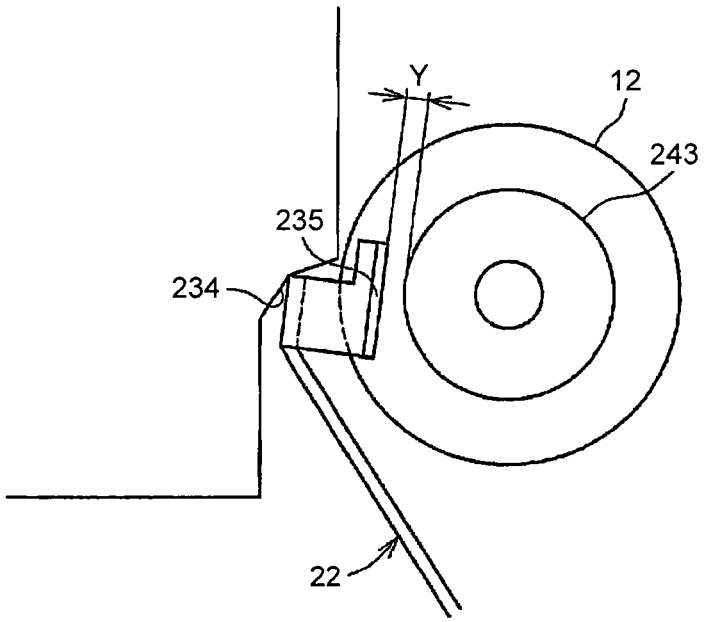


FIG.33

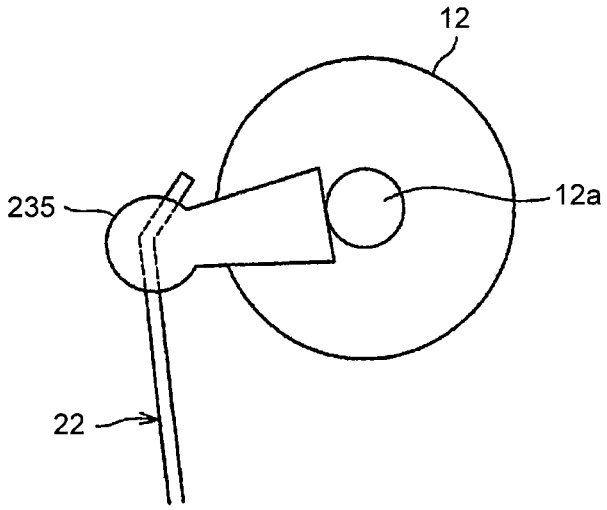


FIG.34

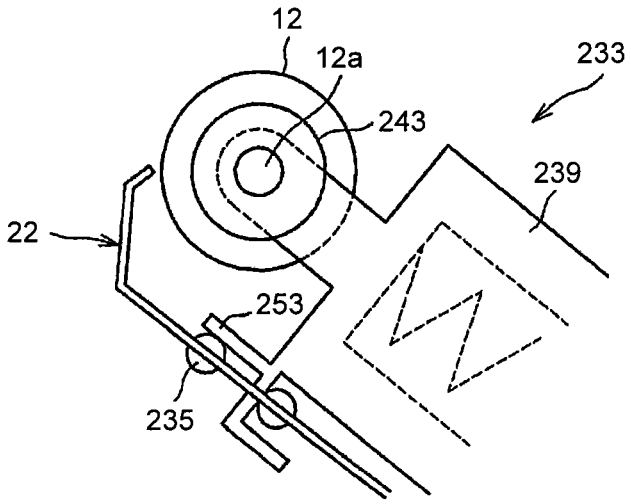


FIG.35

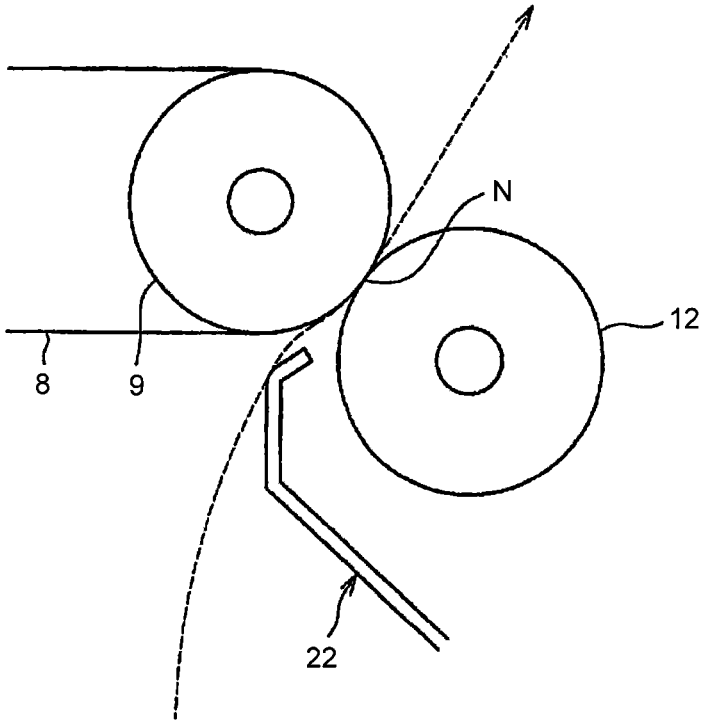
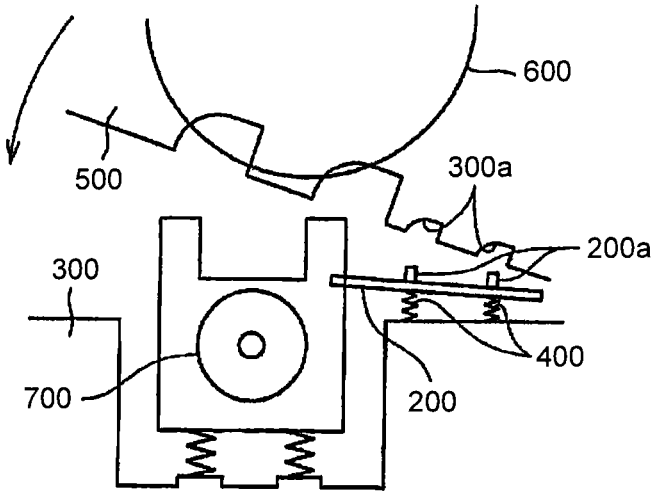


FIG.36



TRANSFER DEVICE AND ATTACHMENT OF THE TRANSFER DEVICE TO A COVER OF AN IMAGE FORMING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application claims priority to and incorporates by reference the entire contents of Japanese Patent Application No. 2012-203910 filed in Japan on Sep. 18, 2012 and Japanese Patent Application No. 2012-263431 filed in Japan on Nov. 30, 2012.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a transfer device and an image forming apparatus.

2. Description of the Related Art

For example, there are known electrophotographic image forming apparatuses in which a secondary transfer unit is attached to a cover of a main body to allow easy handling of a paper jam occurring between a secondary transfer roller and an opposed roller or neighboring parts thereof (see Japanese Patent Application Laid-open No. 2006-259449, Japanese Patent Application Laid-open No. 2009-139436, and Japanese Patent Application Laid-open No. 2011-85867). In this case, when the cover is opened, the secondary transfer roller can be separated from the opposed roller, thereby to facilitate removal of jammed paper.

In some of image forming apparatuses having a secondary transfer unit attached to a cover as described above, the secondary transfer unit is configured to be easy for a user or the like to replace for further improved maintenance properties.

However, on replacement of the secondary transfer unit, when the cover is closed while the secondary transfer unit is imperfectly attached to the cover, the secondary transfer roller may not be correctly positioned, thereby exerting influence on image formation and the like after the replacement. In addition, when the secondary transfer unit is not correctly positioned at closing of the cover, the components may be broken.

The problem of improper attachment of the unit to the cover may also arise in units other than the secondary transfer unit.

Accordingly, in light of the foregoing circumstances, there is needed to provide an image forming apparatus that allows suppression of occurrence of improper attachment of the unit.

SUMMARY OF THE INVENTION

It is an object of the present invention to at least partially solve the problems in the conventional technology.

According to the present invention, there is provided: an image forming apparatus comprising: a main body; a cover configured to be provided so as to be capable of being opened and closed with respect to the main body; an attachment unit configured to be provided on the cover; a unit configured to be attached to the attachment unit; a positioning member configured to, on closing of the cover, position the unit with respect to a member attached to the main body or the main body; a guiding member configured to guide the unit to the positioning member; and a protrusion configured to be provided at the guiding member to protrude in an attaching direction of the unit.

The present invention also provides an image forming apparatus comprising: a main body including a frame; a cover including a hole and configured to be opened and closed with respect to the main body; a transfer roller supporter including a pin and configured to support a transfer roller and to be attached to the cover by inserting the pin into the hole in an attaching direction; a groove provided on the frame and configured to, on closing of the cover, position a shaft of the transfer roller with respect to the frame; a guide provided on the frame and configured to guide the shaft of the transfer roller to the groove; and a protrusion provided on the guide and protruding in the attaching direction.

The present invention also provides a transfer device comprising: a transfer unit configured to transfer an image to a recording medium; a transfer entrance guide configured to be switchable between a guiding position at which to guide the recording medium to the transfer unit and an evacuation position being relatively evacuated from the guiding position; a supporting member that supports the transfer entrance guide in a displaceable manner; a guide positioning member configured to guide the transfer entrance guide at the guiding position; and a guide guiding member configured to guide the transfer entrance guide to the guide positioning member, wherein the transfer device further comprises a guiding auxiliary member, when the transfer entrance guide is guided to the guide positioning member along the guide guiding member, abuts an abutment member of the transfer entrance guide and presses the transfer entrance guide in a guiding direction toward the guide positioning member.

The above and other objects, features, advantages and technical and industrial significance of this invention will be better understood by reading the following detailed description of presently preferred embodiments of the invention, when considered in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic configuration view of a color laser printer as an image forming apparatus according to one embodiment of the present invention;

FIG. **2** is a view illustrating the printer with the cover opened;

FIG. **3** is a view illustrating a support structure and a positioning structure for a secondary transfer roller;

FIG. **4** is a view illustrating the printer with an intermediate transfer unit removed;

FIG. **5** is a view illustrating the printer with a secondary transfer unit detached;

FIG. **6** is a view illustrating the printer with the secondary transfer unit attached;

FIG. **7** is a view for describing a method for attaching the secondary transfer unit;

FIG. **8** is a view for describing a method for attaching the secondary transfer unit;

FIG. **9** is a view illustrating the secondary transfer unit improperly attached;

FIG. **10** is a view illustrating the secondary transfer roller in abutment with a guiding member;

FIG. **11** is a view illustrating the relationships among forces generated on a rotating shaft in abutment with a first guide surface;

FIG. **12** is a view illustrating the relationships among forces generated on the rotating shaft in abutment with a second guide surface;

FIG. **13** is a view illustrating a force generated on a lock member when the rotating shaft is in abutment with the first guide surface;

FIG. **14** is a view illustrating the relationship between a movement locus of the rotating shaft and a movement locus of the cover;

FIG. **15** is a view illustrating rotating action of a movable supporting member;

FIG. **16** is a view illustrating the direction of an abutment force varying with the rotating action of the movable supporting member;

FIG. **17** is a view illustrating forces generated on the lock member when the rotating shaft abuts the second guide surface;

FIG. **18** is a view illustrating a modification example of a protrusion;

FIG. **19** is a view illustrating a configuration in which the cover is moved linearly to open or close the cover;

FIG. **20** is a view illustrating a transfer entrance guide and the secondary transfer roller before being guided;

FIG. **21** is a view illustrating the transfer entrance guide and the secondary transfer roller being guided;

FIG. **22** is a view illustrating the transfer entrance guide and secondary transfer roller after being positioned;

FIG. **23** is a view illustrating FIG. **22** as seen from the right side of FIG. **22**;

FIG. **24** is an enlarged perspective view of one end side of the transfer entrance guide;

FIG. **25** is an enlarged view of the state in which an abutment member is fitted into a guide positioning member;

FIG. **26** is an enlarged view of the state in which the abutment member is in abutment with a shaft bearing;

FIG. **27** is an enlarged view of the state in which the transfer entrance guide is positioned;

FIG. **28** is a view illustrating examples in which the contact unit is formed by part of the transfer entrance guide;

FIG. **29** is an enlarged view of the state in which the transfer entrance guide is in abutment with the shaft bearing;

FIG. **30** is an enlarged view of the state in which the transfer entrance guide is positioned;

FIG. **31** is a view illustrating another example in which the abutment member is formed by part of the transfer entrance guide, and an enlarged view of the state in which the abutment member is in abutment with the shaft bearing;

FIG. **32** is an enlarged view of the state in which the transfer entrance guide is positioned;

FIG. **33** is a view illustrating an example in which the rotating shaft of the secondary transfer roller is in abutment with the abutment member;

FIG. **34** is a view illustrating an example in which part of a supporting member is in abutment with the abutment member;

FIG. **35** is a view illustrating a conveying path of paper guided by the transfer entrance guide; and

FIG. **36** is a view illustrating a configuration of a conventional transfer device.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention will be described below with reference to the attached drawings. Throughout the respective drawings, constitutional elements such as members and components with the same functions or shapes will be given the same reference numerals as much as possible, and these elements will be described only once.

First Embodiment

FIG. **1** is a schematic configuration view of a color laser printer as an image forming apparatus according to one embodiment of the present invention. First, referring to FIG. **1**, an entire configuration and operations of the color laser printer will be described.

As illustrated in FIG. **1**, an image forming apparatus of the embodiment includes an image forming section A that forms an image; a transfer section B that transfers an image to a paper as a recording medium; a paper feeding section C that feeds papers to the transfer section B; a fixing section D that fixes the transferred image on the paper; and a discharging section E that discharges the paper to the outside of the device. In FIG. **1**, a route indicated by a dotted line refers to a conveying path R for conveying the paper from the paper feeding section C to the discharging section E.

Attached to the image forming section A are four process units **1**Y, **1**M, **1**C, and **1**Bk as image forming units that form images of different colors, yellow (Y), magenta (M), cyan (C), and black (Bk) corresponding to color separation elements of color images, so as to be detachable from an image forming apparatus main body **100**. Each of the process units **1**Y, **1**M, **1**C, and **1**Bk includes a drum-shaped photosensitive element **2** as a latent image carrier (image carrier) carrying a latent image on a surface thereof; a roller charging device **3** as charging unit that charges a surface of the photosensitive element **2**; a developing roller **4** as a developing unit that converts the latent image on the photosensitive element **2** into a visible image; and a cleaning blade **5** as a cleaning unit for cleaning the surface of the photosensitive element **2**.

In FIG. **1**, reference numerals are given to only the photosensitive element **2**, the roller charging device **3**, the developing roller **4**, and the cleaning blade **5** included in the process unit **1**Y for yellow images, and no reference numerals are given to those in the other process units **1**M, **1**C, and **1**Bk.

In FIG. **1**, toner hoppers **20** are provided above the respective process units **1**Y, **1**M, **1**C, and **1**Bk such that toner is supplied from the respective toner hoppers **20** to the respective process units **1**Y, **1**M, **1**C, and **1**Bk.

Arranged above the respective toner hoppers **20** is an exposing device **6** as a latent image forming unit that forms electrostatic latent images on the surfaces of the respective photosensitive elements **2**. The exposing device **6** is configured to have a light source, a polygon mirror, an f-θ lens, a reflecting mirror, and the like, and radiate laser light onto the surfaces of the photosensitive elements **2** on the basis of image data.

The transfer section B is provided with a transfer device **7** as a transfer unit that transfers toner images to the paper as a recording medium. The transfer device **7** includes an endless intermediate transfer belt **8** as an intermediate transfer element, four primary transfer rollers **11** as primary transfer members, a secondary transfer roller (a transfer roller) **12** as a secondary transfer member, and a transfer entrance guide **22**.

The intermediate transfer belt **8** is extended by a driving roller **9** and a driven roller **10**. The driving roller **9** is rotated and driven by a drive source not illustrated. When the driving roller **9** rotates counterclockwise in the drawing, the intermediate transfer belt **8** goes round (rotates) in the direction of arrow in the drawing. A belt cleaning device **13** is on the outer peripheral of the intermediate transfer belt **8** at the right end side of the drawing arranged to clean the surface of the intermediate transfer belt **8**.

The four primary transfer rollers **11** are in abutment with the photosensitive elements **2** via the intermediate transfer belt **8**, respectively. Accordingly, the respective photosensitive elements **2** and the intermediate transfer belt **8** are in contact with each other to form primary transfer units (primary transfer nips) for transferring toner images between

these components. The primary transfer rollers **11** are each connected to a power supply not illustrated to apply a predetermined direct-current voltage (DC) and/or an alternating-current voltage (AC) to the primary transfer rollers **11**.

The secondary transfer roller **12** is in abutment with the driving roller **9** via the intermediate transfer belt **8**. This forms a secondary transfer unit (secondary transfer nip) for transferring a toner image between the secondary transfer roller **12** and the intermediate transfer belt **8**. As with the primary transfer rollers **11**, the secondary transfer roller **12** is connected to the power supply not illustrated to apply a predetermined direct-current voltage (DC) and/or an alternating-current voltage (AC) to the secondary transfer roller **12**.

The transfer entrance guide **22** is arranged near the secondary transfer unit on the upstream side in the direction of paper conveyance. The transfer entrance guide **22** guides papers to the secondary transfer unit. In addition, the transfer entrance guide **22** and the secondary transfer roller **12** are supported by a supporting member **23** provided on the cover **101** of the image forming apparatus main body **100**.

The paper feeding section C is provided with a paper feed tray **14** storing paper P, a paper feeding roller **15** feeding the paper P from the paper feed tray **14**, and the like. A pair of registration rollers **16** is arranged as timing rollers in the conveying path R between the paper feeding roller **15** and the secondary transfer roller **12**. The paper P includes thick paper, postcards, envelopes, normal paper, thin paper, coated paper (coat paper, art paper, and the like), tracing paper, and the like. In addition, OHP sheets, OHP films, and the like may be used as recording media.

The fusing section D is provided with a fixing device **17** for fixing a non-fixed image transferred to the paper. The fixing device **17** includes therein a fixing roller **24** having a heating source not illustrated, and a pressing roller **25** pressed by the fixing roller **24**. Fixing nips are formed at places where the both rollers **24** and **25** are in abutment with each other.

The discharging section E is provided with a pair of discharging rollers **18** for discharging papers to the outside of the device and a discharge tray **19** for stocking papers discharged to the outside of the device.

Subsequently, basic operations of the printer according to the embodiment will be described with reference to FIG. **1**.

When an image forming operation is started, the respective photosensitive elements **2** of the respective process units **1**Y, **1**M, **10**, and **1**Bk are rotated and driven clockwise in the drawing by a driving device not illustrated, the surfaces of the respective photosensitive elements **2** are evenly charged with a predetermined polarity by the roller charging device **3**. Based on image information of an original read by a reading device not illustrated, the exposing device **6** radiates laser light onto the charging surfaces of the respective photosensitive elements **2** to form electrostatic latent images on the surfaces of the photosensitive elements **2**. At that time, the image information exposed to the respective photosensitive elements **2** are single-color image information in which a desired full-color image is separated into color information of yellow, magenta, cyan, and black. The respective developing rollers **4** supply toner to the electrostatic latent images formed on the photosensitive elements **2** to convert the electrostatic latent images into visible images (rendering) as toner images.

In addition, when an image forming operation is started, the driving roller **9** over which the intermediate transfer belt **8** extends is rotated and driven to cause the intermediate transfer belt **8** to go round in the direction of arrow in the drawing. Then, when a constant voltage or a voltage subjected to constant current control with a polarity opposite to the charging polarity of the toner is applied to the respective primary transfer rollers **11**, transfer electric fields are formed at primary transfer units between the respective primary transfer rollers **11** and the respective photosensitive elements **2**.

After that, when the toner images of respective colors on the photosensitive elements **2** have reached the first transfer units with rotation of the respective photosensitive elements **2**, the toner images on the photosensitive elements **2** are sequentially transferred in an overlapped manner onto the intermediate transfer belt **8** by the transfer electric fields formed at the primary transfer units. Accordingly, a full-color toner image is carried on the surface of the intermediate transfer belt **8**. In addition, the toner on the respective photosensitive elements **2** not transferred to the intermediate transfer belt **8** is eliminated by the cleaning blade **5**.

At the paper feeding section C, the rotation and driving of the paper feeding roller **15** are started to send out the paper P from the paper feed tray **14** into the conveying path R. The paper P sent out into the conveying path R is temporarily stopped by the registration roller **16**.

After that, the rotation and driving of the registration roller **16** is started at a predetermined timing, and the paper P is conveyed to the secondary transfer unit in a manner timed with the timing at which the toner images on the intermediate transfer belt **8** reaches the secondary transfer unit. At that time, a transfer voltage with a polarity opposite to the toner charging polarity of the toner images on the intermediate transfer belt **8** is applied to the secondary transfer roller **12**, thereby to form a transfer electrical field at the secondary transfer unit. Then, the toner images on the intermediate transfer belt **8** are collectively transferred onto the paper P by the transfer electrical field. The residual toner on the intermediate transfer belt **8** not transferred onto the paper P is removed by the belt cleaning device **13**.

After that, the paper P is conveyed to the fixing device **17**. At the fixing device **17**, the paper P passes through the fixing nip formed between the fixing roller **24** and the pressing roller **25** to fix the toner image to the paper P. Then, the paper P is discharged by the discharging roller **18** to the outside of the device and is stocked on the discharge tray **19**.

The foregoing description is given as to the image forming operation for forming a full-color image on the paper. Alternatively, any one of the four process units **1**Y, **1**M, **1**C, and **1**Bk may be used to form a single-color image, or two or three process units may be used to form a two- or three-color image.

As illustrated in FIGS. **1** and **2**, in the embodiment, the cover **101** provided at the front unit of the image forming apparatus main body **100** is configured to be swingable around a fulcrum **102** provided at the lower unit of the cover **101**. In addition, since the secondary transfer roller **12** and the transfer entrance guide **22** are attached to the cover **101** via the supporting member **23** as described above, the secondary transfer roller **12** and the transfer entrance guide **22** move together with opening or closing of the cover **101**. Specifically, with opening or closing of the cover **101**, the secondary transfer roller **12** is switched between a transfer position in contact with the intermediate transfer belt **8** and an evacuation position evacuated relatively from the transfer position. In addition, with opening or closing of the cover **101**, the transfer entrance guide **22** is switched between a guide position to guide papers to the secondary transfer unit and an evacuation position evacuated relatively from the guide position.

According to the foregoing configuration, even if a paper jam occurs in the conveying path R, the front side of the image forming apparatus main body **100** can be opened by swinging the cover **101** forward to remove the jammed paper in an easy manner. Besides the secondary transfer roller **12** and the

transfer entrance guide **22**, the fixing device **17**, the registration roller **16**, and the discharging roller **18** may also move together with the cover **101**.

FIG. **3** is a view illustrating a support structure and a positioning structure for the secondary transfer roller **12**.

As illustrated in FIG. **3**, the secondary transfer roller **12** is rotatably held by a holding member **28**. The holding member **28** is supported by the supporting member **23** provided at the cover **101**. Specifically, the supporting member **23** of the embodiment includes a fixed supporting member **29** fixed to the inner surface of the cover **101** and a movable supporting member **30** movable with respect to the fixed supporting member **29**. The holding member **28** is attached to the movable supporting member **30**.

The movable supporting member **30** is supported via two movable supporting members **31** and **32** so as to be displaceable with respect to the fixed supporting member **29**. The supporting members **31** and **32** are members such as bosses provided at the movable supporting member **30**, which are movably inserted into hole units **33** and **34** formed at the fixed supporting member **29**, respectively. When the respective supporting members **31** and **32** move in the hole units **33** and **34**, the movable supporting member **30** is movable with respect to the fixed supporting member **29**. Accordingly, the secondary transfer roller **12** and the holding member **28** are displaced in the direction of moving closer to or away from the cover **101**.

Pressing spring **35** is provided as an elastic member between the movable supporting member **30** and the fixed supporting member **29**. The movable supporting member **30** and the secondary transfer roller **12** supported by the movable supporting member **30** are biased by pressing force S of the pressing spring **35** in the direction of separating from the cover **101** (the direction of arrow S in the drawing). In the embodiment, the pressing spring **35** is a compression coil spring. Alternatively, an extension coil spring or a torsion coil spring may be used to bias the movable supporting member **30** in the same manner as described above.

Provided on the image forming apparatus main body side are a concave positioning member (a groove) **36** for positioning the secondary transfer roller **12** and a guiding member (a guide) **37** for guiding the secondary transfer roller **12** to the positioning member **36**. As illustrated in FIG. **3**, a rotating shaft (a shaft) **12***a* of the secondary transfer roller **12** is fitted into the positioning member **36** by a biasing force of the pressing spring **35**, and then the secondary transfer roller **12** is brought into abutment with the driving roller **9** as an opposed member to position the secondary transfer roller **12**.

As illustrated in FIG. **4**, in the embodiment, the positioning members **36** and the guiding members **37** are provided at a pair of supporting frames (frames) **38** of an intermediate transfer unit **39**. The pair of supporting frames **38** supports rotatably the driving roller **9** and the driven roller **10** over which the intermediate transfer belt **8** is extended. The intermediate transfer unit **39** is configured to be attachable to and detachable from the image forming apparatus main body **100**. When the intermediate transfer unit **39** is attached to the image forming apparatus main body **100**, the positioning member **36** and the guiding member **37** are located at functional positions. Providing the supporting frames **38** of the intermediate transfer unit **39** with the functions of the positioning member **36** and the guiding member **37** as in the embodiment, makes it possible to achieve downsizing and low costs of the device. Alternatively, the main body **100** may be provided with a separate member having the functions of the positioning member **36** and the guiding member **37**. Otherwise, the main body **100**, specifically, the frame or the like of the main body **100** may be provided with a member having the functions of the positioning member **36** and the guiding member **37**.

In the embodiment, the secondary transfer roller **12** and the holding member **28** are configured as an integrated secondary transfer unit in a manner detachable from the movable supporting member **30**.

FIG. **5** is a view illustrating the device with the secondary transfer unit (a transfer roller supporter) **40** detached from the movable supporting member **30**, and FIG. **6** is a view illustrating the device with the secondary transfer unit **40** attached to the movable supporting member **30**.

Specifically, the secondary transfer unit **40** includes a pair of insertion members (pins) **41** and a pair of lock members **42** as means for attachment to the movable supporting member **30**. Each of the insertion members **41** is formed by a pin-shaped member. A plurality of (two in FIG. **5**) insertion members **41** is provided in parallel along the longitudinal side of the holding member **28** (in the axial direction of the secondary transfer roller **12**). Each of the lock members **42** is formed by a U-shaped elastic member. One end **42***a* of the lock member **42** is a fixed end fixed to the holding member **28** and the other end **42***b* is a free end. The free end **42***b* of the lock member **42** includes a claw **42***c*. As with the insertion members **41**, a plurality of (two in FIG. **5**) lock members **42** is provided in parallel along the longitudinal side of the holding member **28** (in the axial direction of the secondary transfer roller **12**).

Meanwhile, an attachment unit **50** of the movable supporting member **30** includes a pair of insertion holes (holes) **43** into which the insertion members **41** are inserted and a pair of hooks **44** on which the claws **42***c* of the lock members **42** are hooked.

Next, a method for attaching the secondary transfer unit **40** will be described with reference to FIGS. **7** and **8**.

When the secondary transfer unit **40** is attached to the movable supporting member **30**, the lock members **42** are picked up and elastically deformed by fingers such that the free end **42***b* comes closer to the fixed end **42***a*. Then, in that state, the insertion member **41** is inserted into the insertion hole **43** of the movable supporting member **30**.

As illustrated in FIG. **8**, while the insertion member **41** is inserted into prescribed positions in the insertion hole **43**, when the lock member **42** is released, the free end **42***b* is separated from the fixed end **42***a* by an elastic restoring force. Accordingly, the claw **42***c* is hooked on the hook **44** to lock the secondary transfer unit **40** on the movable supporting member **30**.

Alternatively, the secondary transfer unit **40** may be pressed into the movable supporting member **30** without elastically deforming the lock member **42** by fingers to attach the secondary transfer unit **40**. Specifically, when the claw **42***c* of the lock member **42** comes into abutment with the hook **44**, the lock member **42** is elastically deformed by a pressing force, whereby the claw **42***c* can be locked over the hook **44**. In addition, as illustrated in FIG. **7**, respective leading end surface **42***d* and **44***a* of the claw **42***c* and the hook **44** may be tapered to be inclined with respect to attaching direction Z of the secondary transfer unit **40** (or inserting direction of the insertion member **41**), which allow the claw **42***c* to come over the hook **44** in an easy manner.

To remove the secondary transfer unit **40** from the movable supporting member **30**, the free end **42***b* of the lock member **42** is elastically deformed by fingers so as to come closer to the fixed end **42***a* to release the lock, and then the secondary transfer unit **40** is pulled out.

In the embodiment, it is conceivable that the cover **101** is closed while the secondary transfer unit **40** is improperly

attached (the claw **42***c* is not locked on the hook **44**), as illustrated in FIG. **9**. In such a case, conventionally, this state may affect image formation or cause breakage of components. Accordingly, to solve the problem with improper attachment of the unit, the image forming apparatus according to the present invention is configured in the manner described below.

FIG. **10** is a view illustrating the secondary transfer roller **12** in abutment with the guiding member **37**.

As illustrated in FIG. **10**, when the cover **101** is closed, the rotating shaft **12***a* of the secondary transfer roller **12** abuts the guiding member **37** and moves along the guiding member **37**, thereby to guide the secondary transfer roller **12** to the positioning member **36**. In this arrangement, when it is assumed that a virtual line connecting a start point J at which the rotating shaft **12***a* starts to abut the guiding member **37** and an end point K at which the rotating shaft **12***a* reaches the positioning member **36** is designated as X, the guiding member **37** includes a protrusion **45** protruding in the attaching direction Z of the secondary transfer unit **40** beyond the virtual line X. Accordingly, it is possible to provide the secondary transfer unit **40** with a force in the direction of attachment to the attachment unit **50**, as compared to the case without the protrusion **45**. Therefore, the secondary transfer unit **40** can be easily attached to the attachment unit **50** together with closing of the cover **101**, which makes it possible to suppress improper attachment of the secondary transfer unit **40**.

The protrusion **45** includes a first guide surface **51** that is provided upstream of the direction of guiding the rotating shaft **12***a* to the positioning member **36**, and a second guide surface **52** that is provided downstream of the first guide surface **51** and is set at an angle different from that of the first guide surface **51**.

FIG. **11** is a view illustrating the relationships among forces generated on the rotating shaft **12***a* in abutment with the first guide surface **51**.

As illustrated in FIG. **11**, when the rotating shaft **12***a* of the secondary transfer roller **12** abuts the first guide surface **51** under the pressing force S of the pressing spring **35**, abutment force T_1 acts on the first guide surface **51**. The abutment force T_1 acts in a direction inclined at angle θ_1 toward the positioning member **36** with respect to the direction orthogonal to the first guide surface **51**. Accordingly, force F_1 as a guide surface parallel component of the abutment force T_1 ($T_1 \sin \theta_1$) acts on the rotating shaft **12***a*, and the secondary transfer roller **12** under the force F_1 moves toward the positioning member **36**.

In addition, friction force μN_1 opposite in direction to the force F_1 in the direction toward the positioning member **36** acts on the rotating shaft **12***a*. The friction force μN_1 is expressed by the product of friction coefficient μ and reaction force N_1 acting on the rotating shaft **12***a*. The reaction force N_1 is a force identical in magnitude to a guide surface orthogonal component of the abutment force T_1 ($T_1 \cos \theta_1$) and opposite in direction to the same.

FIG. **12** is a view illustrating the relationships among forces generated on the rotating shaft **12***a* in abutment with the second guide surface **52**.

In this case, the a variety of forces are different in direction and magnitude from those illustrated in FIG. **11**, but the kinds of the forces acting on the rotating shaft **12***a* are basically identical to those illustrated in FIG. **11**. Therefore, when the rotating shaft **12***a* is in abutment with the second guide surface **52**, force F_2 toward the positioning member **36** and friction force μN_2 act on the rotating shaft **12***a*. FIG. **12** illustrates elements T_2, θ_2, F_2, and N_2 corresponding to T_1, θ_1, F_1, and N_1, respectively.

As described in the foregoing, when the rotating shaft **12***a* is in abutment with the respective guide surfaces **51** and **52**, the forces F_1 and F_2 act on the rotating shaft **12***a* in the direction toward the positioning member **36**. In the embodiment, the forces F_1 and F_2 are made larger than the friction forces μN_1 and μN_2. Specifically, the force F_1 and F_2 toward the positioning member **36** are adjusted by setting the angles of the respective guide surfaces **51** and **52** and the direction of the pressing force of the pressing spring **35**. When it is assumed that the abutment force with which the rotating shaft **12***a* is in abutment with the first guide surface **51** or the second guide surface **52** is designated as T, the angle formed by the direction of the abutment force T and the direction orthogonal to the guide surface as θ, the force toward the positioning member **36** as F, the reaction force as N, and the friction coefficient between the secondary transfer roller **12** and the guide surface as μ, the condition expressed in Equation (2) obtained from the relationship expressed in Equation (1) needs to be met as follows:

$$F-\mu N=T \sin \theta-\mu T \cos \theta>0 \quad (1)$$

$$\tan \theta>\mu \quad (2)$$

According to Equation (2), for example, when the friction coefficient μ between the rotating shaft **12***a* formed by applying nickel plating to the surface of an iron shaft and the resin guiding unit **37** is 0.2 to 0.3, the angle θ needs to be 16.7° or more.

When the condition in Equation (2) is met, the force F toward the positioning member **36** becomes larger than the friction force μN, which makes it easier to guide the secondary transfer roller **12** to the positioning member **36**. In addition, the secondary transfer unit **40** can be attached by the force F toward the positioning member **36**. This matter will be described below in detail.

As illustrated in FIG. **13**, when the rotating shaft **12***a* of the secondary transfer roller **12** abuts with the first guide surface **51** with closing of the cover **101**, the force F_1 toward the positioning member **36** acts on the rotating shaft **12***a* as described above. However, the friction force μN_1 opposite in direction to the force F_1 also acts on the rotating shaft **12***a*, and thus a differential force between these forces ($F_1-\mu N_1$) becomes a moving force with which the secondary transfer roller **12** is moved toward the positioning member **36**.

The moving force ($F_1-\mu N_1$) contributes to attachment of the secondary transfer unit **40**. Specifically, of the moving force ($F_1-\mu N_1$), a component parallel to the attaching direction Z of the secondary transfer unit **40** contributes to attachment of the secondary transfer unit **40** as a force moving the secondary transfer unit **40** in the attaching direction Z. When it is assumed that the angle formed by the direction of the moving force ($F_1-\mu N_1$) and the attaching direction Z as α_1, the component parallel to the attaching direction Z is ($F_1-\mu N_1$) $\cos \alpha_1$.

As described in the foregoing, the force generated upon the abutment of the rotating shaft **12***a* with the first guide surface **51** acts as a force for moving the secondary transfer unit **40** in the attaching direction Z. At that time, the force for moving the unit **40** in the attaching direction Z becomes equal to or more than a force needed for the claws **42***c* to come over the hooks **44**, the claws **42***c* are locked over the hooks **44**, which makes it possible to attach completely the secondary transfer unit **40**.

Further, the embodiment is configured in such a manner that, as the rotating shaft **12***a* is guided toward the positioning member **36**, the force for moving the secondary transfer unit **40** in the attaching direction Z increases.

Specifically, as illustrated in FIG. **14**, the embodiment is configured in such a manner that movement locus V of the rotating shaft **12***a* (unit abutment member) abutting the first guide surface **51** and guided to the positioning member **36** and movement locus W of the cover **101** when being closed comes closer to each other in the direction of closing the cover **101**. In the foregoing configuration, when the cover **101** is closed, the pressing spring **35** is compressed and thus the abutment force of the rotating shaft **12***a* with the first guide surface **51** becomes larger. Accordingly, the force for moving the unit **40** in the attaching direction Z increases.

With the foregoing relationship between the movement loci V and W of the rotating shaft **12***a* and the cover **101**, when the cover **101** is closed, the secondary transfer unit **40** is displaced to come closer to the cover **101**. At that time, of the two supporting members **31** and **32** supporting the movable supporting member **30** illustrated in FIG. **15**, the upper supporting member **31** abuts the inner surface of the hole unit **33** and is controlled in movement toward the cover **101**. Meanwhile, the lower supporting member **32** corresponds to the hole unit **34** larger in size than the upper hole unit **33**, the lower supporting member **32** is permitted to move toward the cover **101**. Accordingly, the movable supporting member **30** rotates in the direction of arrow Y in the drawing around the controlled upper supporting member **31**.

As described in the foregoing, when the movable supporting member **30** rotates, the direction of the abutment force of the rotating shaft **12***a* changes accordingly from the direction indicated with T_1 to the direction indicated with T_{10}, as illustrated in FIG. **16**. That is, the angle formed by the direction of the abutment force and the direction orthogonal to the first guide surface **51** increases from θ_1 to θ_{10}, and thus the force toward the positioning member **36** also increases from F_1 to F_{10}. As a result, the force for moving the unit **40** in the attaching direction Z also increases.

As in the foregoing, according to the embodiment, it is possible to increase effectively the force moving the secondary transfer unit **40** in the attaching direction Z by the increase of the pressing force due to the relationship between the movement loci V and W of the rotating shaft **12***a* and the cover **101** and the rotation of the movable supporting member **30**. This facilitates the attachment of the secondary transfer unit **40** when the cover **101** is closed.

Even if, when the rotating shaft **12***a* is in abutment with the first guide surface **51**, the force required for the claws **42***c* to come over the hooks **44** cannot be obtained, in the embodiment, the second guide surface **52** with a different angle is provided to assure the force required for the attachment.

FIG. **17** is a view illustrating forces contributing to attachment of the secondary transfer unit **40** when the rotating shaft **12***a* abuts the second guide surface **52**.

In this case, basically as in the foregoing case, a differential force $(F_2-\mu_2)$ between the force F_2 acting on the rotating shaft **12***a* in the direction toward the positioning member **36** and the friction force μN_2 acts on the secondary transfer unit **40**. Therefore, a component $(F_2-\mu_2)\cos\alpha_2$ of the force parallel to the attaching direction Z becomes the force for moving the secondary transfer unit **40** in the attaching direction Z. In FIG. **17**, the component parallel to the attaching direction Z is smaller than the component parallel to the attaching direction Z illustrated in FIG. **13**. However, the component parallel to the attaching direction Z illustrated in FIG. **17** may be actually set larger according to the relationships with the angle of the second guide surface **52**, the pressing force of the pressing spring **35**, and the like.

Specifically, as illustrated in FIG. **12**, when the rotating shaft **12***a* abuts the second guide surface **52**, the angle of the second guide surface **52** is set such that the angle θ_2 is larger than in the case where the rotating shaft **12***a* abuts the first guide surface **51** as illustrated in FIG. **11**. Accordingly, when the rotating shaft **12***a* abuts the second guide surface **52**, it is possible to obtain the large force F_2 in the direction toward the positioning member **36**, thereby assuring the force needed for the claws **42***c* to come over the hooks **44**.

As described in the foregoing, the secondary transfer unit **40** can be reliably attached by setting at least the second guide surface **52** at an angle at which a force acts on the secondary transfer unit **40** for attachment to the attachment unit when the secondary transfer unit **40** abuts the second guide surface **52**.

In the foregoing, effects and operations of the first guide surface **51** and the second guide surface **52** are described in detail. However, either the first guide surface **51** or the second guide surface **52** may contribute to the attachment of the secondary transfer unit **40**. In short, it is only needed that the guiding member **37** includes the protrusion **45** with which, when the cover **101** is closed, the secondary transfer unit **40** is pressed and attached in the attaching direction Z.

Therefore, the protrusion **45** may be provided across the entire guiding member **37** or at part of the guiding member **37**. In addition, as illustrated in FIG. **18**, the protrusion **45** may have a curved portion.

The present invention is not limited to the configuration in which the cover **101** is rotated for opening or closing as in the foregoing embodiment. The present invention may be applied to the configuration in which the cover **101** is moved linearly in horizontal direction H or the like for opening or closing as illustrated in FIG. **19**. Further, in the foregoing embodiment, the cover **101** is closed to attach the secondary transfer unit **40**. However, the present invention is not limited to this but may be applied to the case where the conveying unit including the registration roller or other detachable units is to be attached.

The system for image formation by the image forming apparatus to which the present invention is applied is not limited to the foregoing electrophotography. The present invention may be applied to devices of arbitrary image forming systems such as ink-jet system. In addition, the image forming apparatus is not limited to a printer but may be a copying machine, a facsimile, or a MFP including these devices.

As in the foregoing, according to the present invention, when the cover is closed, the unit can be moved effectively by the protrusion in the attaching direction. This makes it possible to attach the unit to the attachment unit with closing of the cover, thereby to suppress improper attachment of the unit. As a result, it is possible to avoid malfunction of the device and breakage of the components due to improper positioning of the unit.

In particular, a great advantage can be expected in the configuration of the present invention by applying the present invention to the configuration in which the attaching direction Z of the secondary transfer unit **40** is different from (or intersects with) the pressing direction S of the pressing spring **35** on positioning of the secondary transfer unit **40** as in the foregoing embodiment. In that configuration, it is generally hard to attach the unit to the attachment unit by closing the cover. However, the application of the present invention makes it possible to move the unit effectively in the attaching direction regardless of the relationship between the attaching direction and the pressing direction of the unit.

Second Embodiment

For example, as illustrated in FIG. **36**, Japanese Patent Application Laid-open No. H8-30054 discloses the configuration in which a transfer entrance guide **200** guiding a

recording medium such as papers to a transfer unit transferring an image is attached to a lower unit **300** as a supporting member via a spring **400**. In this configuration, an upper unit **500** supporting a photosensitive element **600** moves vertically with respect to the lower unit **300** supporting a transfer roller **700**. When the upper unit **500** is moved downward for closing, protrusions **200***a* provided at the transfer entrance guide **200** enter guiding members **300***a* provided at the upper unit **500**, and are guided by the guiding members **300***a* to position the upper unit **300**.

When the transfer entrance guide is attached to the lower unit via a spring as in the configuration disclosed in Japanese Patent Application Laid-open No. H8-30054, the transfer entrance guide can be freely positioned within the movement range of the spring. In this case, the positioning accuracy of the transfer entrance guide itself is less affected by the positioning accuracy of the lower unit with respect to the upper unit.

However, when the transfer entrance guide is displaceable with respect to the lower unit, the posture of the transfer entrance guide is unstable, which may cause a problem that the transfer entrance guide cannot be stably guided by the guiding members of the upper unit.

Accordingly, in the embodiment, a transfer device capable of guiding stably the transfer entrance guide to the positioning member, and an image forming apparatus including the transfer device. A general configuration of a color laser printer as image forming apparatus in the embodiment is the same as that illustrated in FIGS. **1** and **2** of the first embodiment, and thus descriptions thereof will be omitted.

Configurations for positioning the transfer entrance guide and the secondary transfer roller when the cover is closed will be described with reference to FIGS. **20** to **24**.

FIG. **20** is a view illustrating the transfer entrance guide and the secondary transfer roller before being guided by guiding members, FIG. **21** is a view illustrating these components being guided, and FIG. **22** is a view illustrating these components after being positioned. FIG. **23** is a side view of FIG. **22** as seen from the right side of FIG. **22**. FIG. **24** is an enlarged perspective view of one end unit of the transfer entrance guide. FIGS. **20** and **21** do not illustrate the cover **101**. FIGS. **20** to **24** are views illustrating a configuration of one end unit of the secondary transfer roller or the transfer entrance guide, and the configurations for positioning these components are bilaterally symmetric, and thus only one of the two configurations will be described below for simplification.

In FIG. **22**, reference numeral **230** denotes a frame arranged on both lateral sides of the intermediate transfer belt **8**. The frame **230** supports rotatably the driving roller **9** and the driven roller **10** over which the intermediate transfer belt **8** is extended. The frame **230** includes an outside plate **231** arranged the outside and an inside plate **232** arranged the inside. The outside plate **231** and the inside plate **232** include concave portions as positioning members **233** and **234** positioning the secondary transfer roller **12** and the transfer entrance guide **22**. In this arrangement, the concave portion formed in the outside plate **231** is the roller positioning member **233** for positioning the secondary transfer roller **12**, and the concave portion formed in the inside plate **232** is the guide positioning member **234** for positioning the transfer entrance guide **22**.

In this case, as illustrated in FIG. **22**, the rotating shaft **12***a* of the secondary transfer roller **12** is fitted into the roller positioning member **233**, and in that state, when the secondary transfer roller **12** abuts the driving roller **9**, the secondary transfer roller **12** is positioned. Meanwhile, the transfer entrance guide **22** is positioned when an abutment member **235** provided at a leading end thereof is fitted into the guide positioning member **234**.

The outside plate **231** and the inside plate **232** include guiding members (roller guiding member **247** and guide guiding member **248**) for guiding the secondary transfer roller **12** and the transfer entrance guide **22** to the respective positioning members **233** and **234** (see FIG. **21**). In the embodiment, the secondary transfer roller **12** is guided when the rotating shaft **12***a* of the secondary transfer roller **12** abuts the roller guiding member **247** provided on the outside plate **231**. Meanwhile, the transfer entrance guide **22** is guided when the abutment member **235** abuts the guide guiding member **248** provided on the inside plate **232**.

A supporting member **223** supporting the secondary transfer roller **12** and the transfer entrance guide **22** includes a fixed supporting member **238** fixed to the inner surface of the cover **101** and a movable supporting member **239** movable with respect to the fixed supporting member **238**. The secondary transfer roller **12** is supported by the movable supporting member **239**. Specifically, a pair of arms **242** extending from the movable supporting member **239** includes shaft bearings **243**, respectively. The both ends of the rotating shaft **12***a* of the secondary transfer roller **12** are rotatably inserted into the respective shaft bearings **243**. The movable supporting member **239** is attached to the fixed supporting member **238** via a roller pressing spring **236** as an elastic member. Accordingly, the secondary transfer roller **12** is supported in a manner displaceable to some extent with respect to the fixed supporting member **238** or the cover **101**.

The roller pressing spring **236** in the embodiment is a compression coil spring. The movable supporting member **239** and the secondary transfer roller **12** supported by the movable supporting member **239** are biased by the roller pressing spring **236** in the direction of separating from the cover **101**. The movable supporting member **239** and the fixed supporting member **238** are provided with control units **240** and **241**, respectively, to, by abutment with each other, control a specific amount or more of protrusion of the movable supporting member **239** with respect to the fixed supporting member **238** against the biasing force of the roller pressing spring **236** (see FIG. **20**).

The transfer entrance guide **22** is attached to the fixed supporting member **238** via a guide pressing spring **237** as an elastic member. Thus, as with the secondary transfer roller **12**, the transfer entrance guide **22** is supported so as to be displaceable to some extent with respect to the fixed supporting member **238** or the cover **101**. In the embodiment, the guide pressing spring **237** is a compression coil spring, and the transfer entrance guide **22** is subject to a pressing force of the guide pressing spring **237** at a receiving unit **244** provided at a base unit thereof. Accordingly, as with the secondary transfer roller **12**, the transfer entrance guide **22** is biased in the direction of separating from the cover **101**. The guide pressing spring **237** may not be a compression coil spring but may be an extension coil spring, torsion spring, or the like.

The transfer entrance guide **22** is provided with a stopper **245** to abut part of the movable supporting member **239** (an opposed member different from the transfer entrance guide **22**) to control a specific amount or more of protrusion of the transfer entrance guide **22** with respect to the fixed supporting member **238** against the biasing force of the guide pressing spring **237** (see FIG. **20**).

Specifically, as illustrated in FIG. **24**, the stopper **245** is formed by a cylindrical protrusion protruding from the transfer entrance guide **22** toward the movable supporting member **239**. Meanwhile, the movable supporting member **239** is pro-

vided with a groove-shaped insertion member **246** into which the stopper **245** is inserted. The stopper **245** is movable along the insertion member **246**, which allows the transfer entrance guide **22** to move back and forth with respect to the fixed supporting member **238**. However, when the stopper **245** abuts a control surface **246***a* (opposed to the biasing force of the guide pressing spring **237**) of the insertion member **246**, a specific amount or more of protrusion of the transfer entrance guide **22** with respect to the fixed supporting member **238** is controlled. While the stopper **245** is in abutment with the control surface **246***a*, the transfer entrance guide **22** is held by the guide guiding member **248** at a position where the transfer entrance guide **22** is capable of being guided.

In the embodiment, the abutment member **235** is formed separately from the transfer entrance guide **22**. As illustrated in FIG. **24**, the abutment member **235** is attached to the transfer entrance guide **22** by inserting a convex portion **251** provided at a lateral end unit of the transfer entrance guide **22** into a hole **252** of the abutment member **235**.

FIG. **35** illustrates a conveying path of paper guided by the positioned transfer entrance guide **22** with a dotted line. In the embodiment, the paper is guided to come into abutment with the intermediate transfer belt **8** near a secondary transfer unit (secondary transfer nip) N on the upstream side in the conveying direction. The paper is guided in the foregoing conveying path to cause the paper to start to abut the intermediate transfer belt **8** near the secondary transfer unit N on the upstream side in the conveying direction where toner on the intermediate transfer belt **8** may be dispersed under influence of a transfer electric field, thereby achieving favorable image transfer. Accordingly, the transfer entrance guide **22** needs to be positioned with accuracy.

However, in general, when the transfer entrance guide **22** and the secondary transfer roller **12** are supported by the same supporting member, there is a problem that the position of the transfer entrance guide **22** may be changed under influence of fluctuations in the position of the secondary transfer roller **12** during paper feeding to the secondary transfer unit. Specifically, when the paper enters into the secondary transfer unit, the secondary transfer roller **12** separates from the intermediate transfer belt **8** by the thickness of the paper, the position of the transfer entrance guide **22** fluctuates under influence of the separation. As the position of the transfer entrance guide **22** fluctuates, the conveying path of the guided paper changes, which may lead to deterioration of image quality.

In contrast to this, in the embodiment, the transfer entrance guide **22** is configured to be less susceptible to influence of fluctuations in the position of the secondary transfer roller **12** during paper feeding. Specifically, as illustrated in FIG. **22**, while the transfer entrance guide **22** is positioned, the stopper **245** of the transfer entrance guide **22** is separated from the control surface **246***a* of the movable supporting member **239**. That is, when the stopper **245** and the control surface **246***a* are separated from each other in the direction in which the secondary transfer roller **12** fluctuates in position during paper feeding (the direction of the thickness of the paper), even when the movable supporting member **239** fluctuates in position according to fluctuation in the position of the secondary transfer roller **12**, it is possible to suppress the following of the movable supporting member **239** by the transfer entrance guide **22**.

As illustrated in FIG. **22**, while the transfer entrance guide **22** is positioned, the stopper **245** is in abutment with the movable supporting member **239** at a place indicated with H in the drawing. In the embodiment, the abutment place H is set distant from the abutment member **235**. Specifically, the abutment place H is set distant from the abutment member **235** by providing the stopper **245** closer to the base unit of the transfer entrance guide **22**. Accordingly, even when the movable supporting member **239** is displaced, it is possible to reduce the amount of displacement of the movable supporting member **239** in the direction of rotating with respect to the abutment member **235** because the abutment place H is distant from the positioned abutment member **235**.

FIG. **25** is an enlarged view of the state in which the abutment member is fitted into the guide positioning member.

As illustrated in FIG. **25**, the transfer entrance guide **22** is positioned by bringing an arc-shaped outer peripheral surface **235***a* of the abutment member **235** into abutment with two sides **234***a* and **234***b* arranged in a triangle shape of the guide positioning member **234**. In this state, when the movable supporting member **239** is displaced, the transfer entrance guide **22** rotates with respect to the center of the arc-shaped outer peripheral surface **235***a* of the abutment member **235** as illustrated with two-dot chain lines in FIG. **25**. At that time, since center G of the arch-shaped outer peripheral surface **235***a* does not change in position, it is preferred to provide a contact unit that contacts with the paper in the transfer entrance guide **22** at or near the center of the arch-shaped outer peripheral surface **235***a*. When the contact unit that contacts with the paper is provided at that position, the contact unit hardly changes in position even with displacement of the movable supporting member **239**, thereby achieving further improvement of guiding accuracy of paper.

Next, guiding operations of the transfer entrance guide **22** and the secondary transfer roller **12** with closing of the cover **101** will be described with reference to FIGS. **20** to **22**.

First, as illustrated in FIG. **20**, before the transfer entrance guide **22** and the secondary transfer roller **12** are guided by the respective guiding members **247** and **248**, the abutment member **235** at the leading end side of the transfer entrance guide **22** is held in abutment with the shaft bearing **243** of the secondary transfer roller **12**. Specifically, in the state illustrated in FIG. **20**, the stopper **245** of the transfer entrance guide **22** is held at a predetermined position in abutment with the control surface **246***a* of the movable supporting member **239**. When the transfer entrance guide **22** rotates around the stopper **245** clockwise in the drawing, the abutment member **235** abuts the shaft bearing **243**. At that time, rotation moment M is generated at the transfer entrance guide **22** as direction F of the pressing force of the guide pressing spring **237** applied to the transfer entrance guide **22** is shifted with respect to the stopper **245** as rotation center. Accordingly, while the abutment member **235** and the shaft bearing **243** are in abutment with each other, the transfer entrance guide **22** and the secondary transfer roller **12** move closer to the guiding members **247** and **248**, respectively.

As illustrated in FIG. **21**, when the rotating shaft **12***a* of the secondary transfer roller **12** abuts the roller guiding member **247** and the abutment member **235** of the transfer entrance guide **22** abuts the guide guiding member **248**, the secondary transfer roller **12** and the transfer entrance guide **22** are guided to the positioning members **233** and **234**, respectively. At that time, as described in the foregoing, the abutment member **235** and the shaft bearing **243** are guided in abutment with each other. In addition, when the rotating shaft **12***a* of the secondary transfer roller **12** abuts the roller guiding member **247**, the secondary transfer roller **12** is pressed in the direction of coming closer to the fixed supporting member **238**, and the respective control units **240** and **241** of the movable supporting member **239** and the fixed supporting member **238** are separated from each other. Further, when the abutment member **235** abuts the guide guiding member **248**, the transfer entrance guide **22** is also pressed in the direction of coming

closer to the fixed supporting member **238**, and the stopper **245** is separated from the control surface **246***a*.

After that, when the rotating shaft **12***a* of the secondary transfer roller **12** reaches the roller positioning member **233**, as illustrated in FIG. **22**, the rotating shaft **12***a* is pressed into the concave portion constituting the roller positioning member **233** by resilience of the roller pressing spring **236**. As a result, the secondary transfer roller **12** abuts the driving roller **9** (via the intermediate transfer belt **8**), and thus the secondary transfer roller **12** is positioned.

At almost the same time, the abutment member **235** of the transfer entrance guide **22** reaches the guide positioning member **234**, as illustrated in FIG. **22**, the abutment member **235** is pressed into the guide positioning member **234** by resilience of the guide pressing spring **237**. Accordingly, the transfer entrance guide **22** is positioned with a leading end located at a predetermined position near the secondary transfer unit.

In reverse, although detailed descriptions are omitted, when the cover **101** is opened, the secondary transfer roller **12** and the transfer entrance guide **22** are accordingly separated from the respective positioning members **233** and **234** and guided along the respective guiding members **247** and **248** in the direction opposite to that at the closing of the cover **101**.

As described in the foregoing, in the configuration of the embodiment, when the transfer entrance guide **22** is guided to the guide positioning member **234**, the abutment member **235** is brought into abutment with the shaft bearing **243** of the secondary transfer roller **12**, which makes it possible to press the transfer entrance guide **22** while supporting the same by the shaft bearing **243**. Accordingly, it is possible to stabilize the posture of the abutment member **235** until coming into abutment with the guide guiding member **248** and move smoothly the abutment member **235** guided by the guide guiding member **248**. Thus, according to the configuration of the embodiment, even when the transfer entrance guide **22** is supported so as to be capable of displacement, the transfer entrance guide **22** can be stably guided to the guide positioning member **234**.

In particular, in the configuration in which the transfer entrance guide **22** is biased toward the guiding surface of the guide guiding member **248** as in the embodiment, there is a possibility that the guiding of the transfer entrance guide **22** is hindered by the biasing force. Therefore, it can be expected that applying the present invention to the foregoing configuration will produce a great advantage.

In the embodiment, as illustrated in FIG. **24**, the abutment member **235** includes a circular cylindrical portion **235***b* and a trapezoidal portion **235***c* provided at one end of the circular cylindrical portion **235***b*. The abutment member **235** abuts the shaft bearing **243** at a planar surface portion **235***d* of the trapezoidal portion **235***c*. Accordingly, when the abutment member **235** is brought into abutment with the shaft bearing **243** at the planar surface portion **235***d*, it is easier to allow the abutment member **235** to abut the shaft bearing **243** and stabilize the posture of the transfer entrance guide **22** in the abutted state, as compared to the case where the abutment member **235** is brought into abutment with the shaft bearing **243** at the circular cylindrical portion **235***b*.

In addition, in the embodiment, while the abutment member **235** is in abutment with the shaft bearing **243** (as illustrated in FIG. **20** and FIG. **21**), a gap X intervenes between the leading end of the transfer entrance guide **22** and the roller surface of the secondary transfer roller **12**, as illustrated in FIG. **26**. Thus, when the leading end of the transfer entrance guide **22** is held in non-contact with the roller surface, it is possible to avoid occurrence of scratches, damage, and the like on the roller surface by contact of the leading end of the transfer entrance guide **22** with the roller surface. This state (in which the leading end of the transfer entrance guide **22** is held in non-contact with the roller surface) is kept at any time even when the cover **101** is fully opened.

In the embodiment, while the abutment member **235** is positioned by the guide positioning member **234** (as illustrated in FIG. **22**), a gap Y intervenes between the abutment member **235** and the shaft bearing **243** as illustrated in FIG. **27**. Thus, when the positioned abutment member **235** is held in non-contact with the shaft bearing **243**, it is possible to prevent influence of variations in the position of the shaft bearing **243** on the abutment member **235**, thereby achieving improvement in the positioning accuracy of the abutment member **235**.

In addition, while the abutment member **235** is positioned by the guide positioning member **234**, a gap Z intervenes between the leading end of the transfer entrance guide **22** and the roller surface of the secondary transfer roller **12**, as illustrated in FIG. **27**. The gap Z is set larger than the gap Y between the abutment member **235** and the shaft bearing **243** (Z>Y). Thus, setting the foregoing relationship between the gap Y and the gap Z makes it possible to prevent the leading end of the transfer entrance guide **22** from contacting the roller surface when the abutment member **235** abuts the shaft bearing **243**.

The present invention is not limited to the foregoing embodiment but may be modified in various manners without deviating from the gist of the present invention.

In the foregoing embodiment, the abutment member **235** is formed separately from the transfer entrance guide **22** (see FIG. **24**). Alternatively, the abutment member **235** may be formed by part of the transfer entrance guide **22** as illustrated in FIGS. **28**(*a*) and **28**(*b*), for example. In the example illustrated in FIG. **28**(*a*), the leading end side of the transfer entrance guide **22** is bent in an L shape, and the bent portion is in abutment with the guide positioning member **234**, as the abutment member **235**. In addition, in the example illustrated in FIG. **28**(*b*), the leading end side of the transfer entrance guide **22** is bent in a U shape, and the bent portion is in abutment with the guide positioning member **234**, as the abutment member **235**.

As described in the foregoing, when the abutment member **235** is formed by part of the transfer entrance guide **22**, it is possible to reduce parts count as compared to the case where the abutment member **235** is formed as a separate component. Conversely, when the abutment member **235** is formed as a separate component, the abutment member **235** and the transfer entrance guide **22** can be advantageously formed by different materials. Further, the shape of the transfer entrance guide **22** itself can be simplified, which makes it possible to avoid increases in cost and placement space resulting from complication of the shape of the transfer entrance guide **22**.

As illustrated in FIG. **29**, the transfer entrance guide **22** itself may be in abutment with the shaft bearing **243** of the secondary transfer roller **12**. In this example, although the leading end of the transfer entrance guide **22** as the abutment member **235** is in abutment with the shaft bearing **243**, the outer diameter of the shaft bearing **243** is made larger than the other diameter of the secondary transfer roller **12**, thereby to avoid the leading end of the transfer entrance guide **22** from contacting the roller surface of the secondary transfer roller **12**.

Also in the example illustrated in FIG. **29**, while the transfer entrance guide **22** is positioned by the guide positioning member **234**, the leading end of the transfer entrance guide **22** is desirably separated from the shaft bearing **243** and in non-

contact with the shaft bearing **243**, as illustrated in FIG. **30**. This makes it possible to improve the positioning accuracy of the transfer entrance guide **22**, as in the foregoing embodiment.

As illustrated in FIGS. **31**(*a*) and **31**(*b*), the leading end of the transfer entrance guide **22** may include a portion extended toward the shaft bearing **243**, which is the abutment member **235** in abutment with the shaft bearing **243**. Also in this example, while the abutment member **235** is in abutment with the shaft bearing **243**, the gap X desirably intervenes between the leading end of the transfer entrance guide **22** and the roller surface of the secondary transfer roller **12**.

In the example illustrated in FIG. **31**, while the transfer entrance guide **22** is positioned by the guide positioning member **234**, the abutment member **235** can be separated from the shaft bearing **243** as illustrated in FIG. **32** to improve the positioning accuracy of the transfer entrance guide **22** as in the foregoing examples.

In the foregoing embodiments, the shaft bearing **243** is used as a guiding auxiliary member to assist the guidance by pressing the transfer entrance guide **22** in the direction of guiding toward the guide positioning member **234**. However, the configuration of the present invention is not limited to this.

For example, as illustrated in FIG. **33**, the rotating shaft **12***a* of the secondary transfer roller **12** may be in abutment with the abutment member **235** to function as a guiding auxiliary member. Otherwise, as illustrate in FIG. **34**, the supporting member **223** (the movable supporting member **239** in this example) may be provided with a protrusion **253** so that the abutment member **235** is pressed by the protrusion **253** to allow the supporting member **223** to function as a guiding auxiliary ember. When the rotating shaft **12***a* is used as a guiding auxiliary member, the configuration may be simplified. However, when the rotating shaft **12***a* is thin, it is difficult to make abutment between the rotating shaft **12***a* and the abutment member **235**, and thus using the shaft bearing **243** or the supporting member **223** as a guiding auxiliary member makes it easier to bring the rotating shaft **12***a* into abutment with the abutment member **235**.

The present invention can be applied to the configuration in which the transfer unit (primary transfer unit) transferring an image on the photosensitive element **600** directly to the paper, and the configuration in which the transfer entrance guide **200** does not come into contact with or separate from the guide guiding member (guiding member **300***a*) but the guide guiding member comes into contact with or separates from the transfer entrance guide **200**, as illustrated in FIG. **36**. The image forming apparatus to which the present invention can be applied is not limited to a color laser printer as illustrated in FIG. **1** but may be any other printer, copying machine, or MFP including these devices, or the like.

According to the present invention, on closing of the cover, the unit can be effectively moved by the protrusion in the direction of attachment. Accordingly, it is possible to attach the unit to the attachment unit on closing of the cover, thereby suppressing occurrence of improper attachment of the unit.

Although the invention has been described with respect to specific embodiments for a complete and clear disclosure, the appended claims are not to be thus limited but are to be construed as embodying all modifications and alternative constructions that may occur to one skilled in the art that fairly fall within the basic teaching herein set forth.

What is claimed is:

1. An image forming apparatus, comprising:

a main body;

a cover configured to be provided so as to be capable of being opened and closed with respect to the main body;

an attachment unit configured to be provided on the cover;

a unit configured to be attached to the attachment unit;

a positioning member configured to, on closing of the cover, position the unit with respect to a member attached to the main body or the main body;

a guiding member configured to guide the unit to the positioning member;

a protrusion configured to be provided at the guiding member to protrude in an attaching direction of the unit; and

a lock member at which the unit attached to the attachment unit is hooked and locked on a hook of the attachment unit.

2. The image forming apparatus according to claim **1**, wherein the protrusion is provided between a start point at which, when the cover is closed, the unit starts to abut the main body or the member attached to the main body, and the positioning member.

3. The image forming apparatus according to claim **1**, wherein the protrusion includes a guide surface exerting a force on the unit, upon abutment with the unit, to allow the unit to be able to be attached to the attachment unit.

4. The image forming apparatus according to claim **3**, wherein

the protrusion includes a first guide surface provided upstream of a direction of guiding the unit to the positioning member and a second guide surface provided downstream of the first guide surface and is set at an angle different from that of the first guide surface, and

at least the second guide surface is set at an angle at which a force acts on the unit to allow the unit to be able to be attached to the attachment unit upon abutment with the unit.

5. The image forming apparatus according to claim **1**, wherein an abutment force with which the unit abuts the guiding member acts in a direction inclined toward the positioning member with respect to a direction orthogonal to the guiding member.

6. The image forming apparatus according to claim **5**, wherein, when it is assumed that an angle formed by the direction of the abutment force with which the unit abuts the guiding member and the direction orthogonal to the guiding member is designated as θ and the friction coefficient between the unit and the guiding member is designated as μ, $\tan\theta > \mu$ is held.

7. The image forming apparatus according to claim **6**, wherein

the unit is configured to be displaceable with respect to the cover, and

when the cover is closed, the unit is displaced by abutment with the guiding member to increase the angle θ.

8. The image forming apparatus according to claim **5**, wherein

the cover is provided with an elastic member to bias the unit toward the positioning member and the guiding member, and

a movement locus of the unit abutment member abutting the guiding member and guided to the positioning member and a movement locus of the cover being closed, come closer to each other in the direction of closing the cover.

9. The image forming apparatus according to claim **1**, wherein the unit comprises

an insertion member that is inserted into an insertion hole provided in the attachment unit.

10. The image forming apparatus according to claim 1, further comprising an elastic member configured to press the unit toward the positioning member and the guiding member, wherein

the attaching direction of the unit and the pressing direction of the elastic member when positioning the unit at the positioning member intersect each other.

11. An image forming apparatus, comprising:

a main body including a frame;

a cover including a hole and configured to be opened and closed with respect to the main body;

a transfer roller supporter including a pin and configured to support a transfer roller and to be attached to the cover by inserting the pin into the hole in an attaching direction;

a groove provided on the frame and configured to, on closing of the cover, position a shaft of the transfer roller with respect to the frame;

a guide provided on the frame and configured to guide the shaft of the transfer roller to the groove; and

a protrusion provided on the guide and protruding in the attaching direction.

12. The image forming apparatus according to claim 11, wherein the transfer roller supporter includes a claw and the cover includes a hook on which the claw is hooked when the pin is inserted into the hole.

13. A transfer device, comprising:

a transfer unit configured to transfer an image to a recording medium;

a transfer entrance guide configured to be switchable between a guiding position at which to guide the recording medium to the transfer unit and an evacuation position being relatively evacuated from the guiding position;

a supporting member that supports the transfer entrance guide in a displaceable manner;

a guide positioning member configured to guide the transfer entrance guide at the guiding position; and

a guide guiding member configured to guide the transfer entrance guide to the guide positioning member, wherein

the transfer device further comprises a guiding auxiliary member, when the transfer entrance guide is guided to the guide positioning member along the guide guiding member, abuts an abutment member of the transfer entrance guide and presses the transfer entrance guide in a guiding direction toward the guide positioning member.

14. The transfer device according to claim 13, wherein an elastic member is provided to bias the transfer entrance guide toward a guide surface of the guide guiding member.

15. The transfer device according to claim 14, wherein the transfer entrance guide is provided with a stopper that abuts another member different from the transfer entrance guide to control displacement of the transfer entrance guide against a biasing force of the elastic member and hold the transfer entrance guide at a position capable of guiding the transfer entrance guide by the guide guiding member.

16. The transfer device according to claim 15, wherein, while the stopper is in abutment with the other member to control displacement of the transfer entrance guide, the transfer entrance guide is rotated around the stopper by the biasing force of the elastic member to bring the abutment member into abutment with the guiding auxiliary member.

17. The transfer device according to claim 13, wherein, while the transfer entrance guide is positioned by the guide positioning member, the guiding auxiliary member is in non-contact with the abutment member of the transfer entrance guide.

18. The transfer device according to claim 13, wherein

the supporting member is provided with one of transfer members in a pair constituting the transfer unit by abutment with each other, and

while the guiding auxiliary member and the abutment member are in abutment with each other, the transfer entrance guide is in non-contact with the transfer member.

19. The transfer device according to claim 18, wherein

the transfer member is a transfer roller rotatably supported by the supporting member via a shaft bearing, and

the guiding auxiliary member is a shaft bearing for the transfer roller.

20. The transfer device according to claim 18, wherein

the transfer member is a transfer roller rotatably supported by the supporting member via a shaft bearing, and

the guiding auxiliary member is a rotating shaft of the transfer roller.

21. The image forming apparatus according to claim 1, wherein the unit is removable from the attachment unit.

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